THE PERFECT GAMING MOUSE
Pick the right gaming rodent with our supertest PG. 26

DESKTOP POWER FROM A LAPTOP!
Introducing MSI's GS30 with Gaming Dock PG. 82

IS THERE LIFE BEYOND STEAM?
Can you survive without Valve's dominant gaming platform? PG. 48

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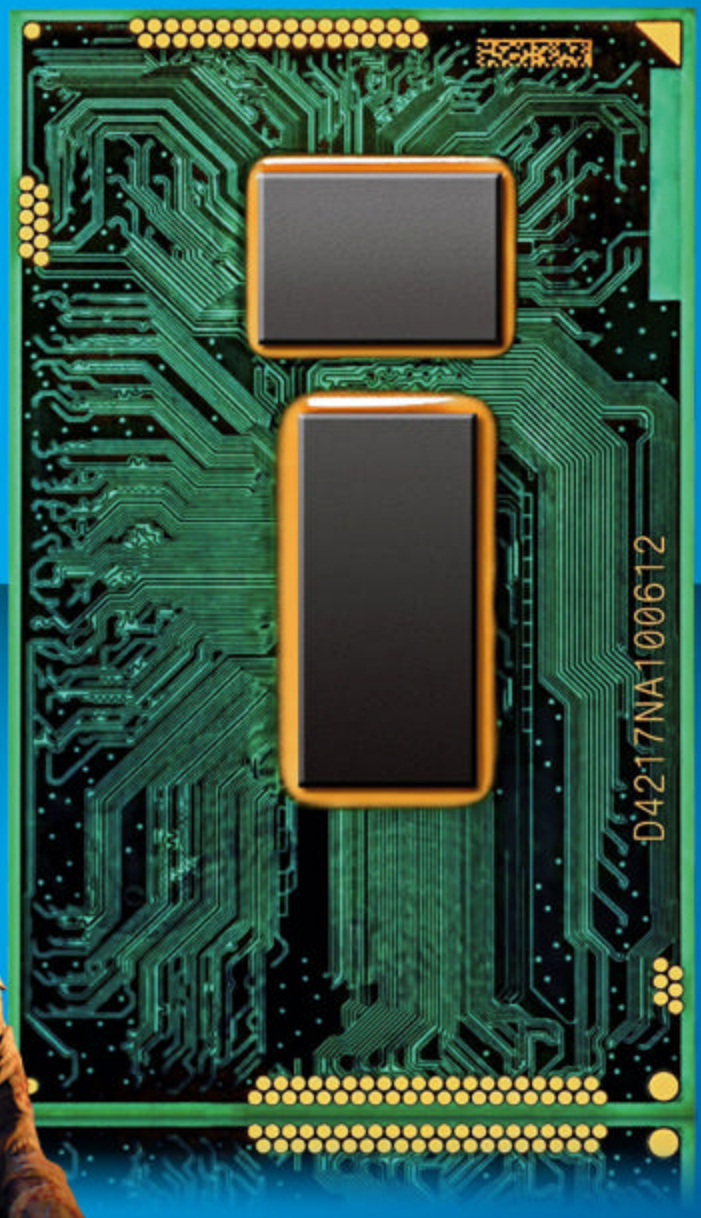

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PG. 88

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inside

MAY 2015

GAMING MOUSE SUPERTEST 26

26 GAMING MOUSE SUPERTEST
Power up your gaming prowess by finding the perfect mouse, as we put 14 top rodents through their paces.

40 BROADWELL'S HERE AT LAST
An inside look at Intel's all-new 14nm CPU. Find out what it can do, if it was worth the wait, and what's coming next.

48 SURVIVING WITHOUT STEAM
The Steam empire won't last forever, so discover what the future looks like without it, for gamers and developers.

QUICKSTART

12 THE NEWS
Dubious software on Lenovo PCs; FCC's net neutrality victory; Office 365 free worldwide for schools.

18 THE LIST
Eight most awesome co-op games.

20 HEAD TO HEAD
We pit the Oculus Rift against the Microsoft HoloLens.

FCC head Tom Wheeler led charge to protect net neutrality.

R&D

56 AUTOPSY
Pulling apart the Dell XPS 13 laptop.

59 HOW TO
Set up an Instant Messaging service; record Skype calls; make stunning cinemagraphs; beautify your desktop.

68 BUILD IT
We put together a super-quiet PC, without sacrificing performance.

LETTERS

22 DOCTOR

94 COMMENTS

IN THE LAB

76 GIGABYTE BRIX S

84 ASUS G751JY

86 SAMSUNG 850 EVO M.2 500GB

88 *DYING LIGHT*

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Tuan Nguyen

BROADWELL: BETTER LATE THAN NEVER

A NEW CPU FROM INTEL? That's classic *Maximum PC* material. But Intel's new Broadwell processors are a bit different. Along with the usual new-hardware hotness that comes with an updated Intel architecture, Broadwell brings with it a little confusion.

Broadwell's hotness is thanks to its cutting-edge 14nm transistors, which help get Moore's Law back on track and take another step toward putting genuine desktop PC processing into almost any package, regardless of proportions. Insane performance might be the *Maximum PC* mission statement. But the things power efficiency makes possible are game changers, too. Broadwell also ups Intel's integrated graphics ante. Always welcome.

The Broadwell confusion comes in two forms. For starters, Intel still hasn't officially launched the desktop versions of Broadwell or even quad-core mobile models. All we have are dual-core mobile models. The rest are coming. But this is one of the strangest, most painfully drawn-out launches in Intel's history.

Then there's Broadwell's increasingly close proximity to the arrival of what comes next from Intel, the SkyLake architecture. The problem is primarily a scheduling issue due to Broadwell's late arrival. But it's going to generate some unprecedented weirdness if, as we expect, Intel ends up charging more money for what will by then be last-gen Broadwell K CPUs on the inferior 9 Series chipset, compared with the latest and greatest Skylake processors and their fancy new 100 Series platform with added PCI Express goodies. To find out what Broadwell's delay means for everything from PC performance to the future of Moore's Law, turn to page 40.

Meanwhile, bearded gaming sage extraordinaire Dan Griliopoulos takes a look at what life would be like without Steam. Frustrating and fantastic, albeit more often the latter, Steam has radically changed the way we buy games, the way we play games, and the way we interact with other gamers. It's also shaken up game development and financial funding, mostly for the better.

But all empires eventually crumble. So it cannot, it will not, last forever. So, how might you go about surviving without Steam and what might gaming in the future look like, both for gamers and developers, in the inevitable post-Steam era? For answers, hop over to page 48, and grab a sneak peak of the shape of things to come.

And finally, mice. Input devices, you might think, are mundane and functional. But having read Ian Evenden's rodent supertest, I laughed, I cried, I decided to buy a new mouse. OK, I didn't cry. But I learned a thing or three. You might, too, starting on page 26.

Tuan Nguyen is Maximum PC*'s editor-in-chief, also known as "the pointy end of the stick." He's been writing, marketing, and raising hell in the tech industry for 19 years.*

↘ submit your questions to: comments@maximumpc.com

THE NEWS

Something Fishy This Way Comes

Software installed on Lenovo PCs uses questionable methods

WHEN WE SURF our favorite websites and check our email, there's a lot of technical activity going on in the background that can be difficult for the layman to break down. But one thing we're sure of is the meaning of a locked padlock in the address bar when we visit our bank's website or any other secure online location. It means our communications with the site are encrypted. And in this circumstance, the address has "HTTPS" at the front instead of "HTTP." Putting aside the possibility of interference by government authorities, we could be reasonably sure that random hackers couldn't access our personal data. But a recent revelation from system manufacturer Lenovo has changed all that.

Between September 2014 and February 2015, Lenovo pre-installed a piece of software called "Superfish VisualDiscovery" on some of its laptops. This program analyzes images on your screen and uses the information gathered to inject advertisements into your Internet browser. Over the years, large-scale system manufacturers like Lenovo, HP, Dell, and Sony have used pre-installed software to help subsidize the cost of the product, so this turn of events is not unusual.

What's unusual is that Superfish has to get past your browser's standard security methods to inject ads. It does so by signing its own HTTPS certificate, essentially acting as its own judge and jury. With no third party to authenticate the validity of Superfish's behavior, the program could look as though it were sending you to a genuine HTTPS website for your bank (or other presumably secure website) but really be pointing you to pretty much anywhere. We have no reason to believe that Superfish was doing so, but the problem doesn't end there. VisualDiscovery was also using a very weak password to protect the certificate, a password that is now known to the public.

Ordinarily, when you click on an HTTPS link, you are sent to a website that's authorized to be on the other end, and it proves its authorization by producing the password for the certificate, and the password has been given to it by the certificate authority. This password is very complex and can change frequently, further enhancing security. When the password never changes, it's easy to guess. When it's known to the public, the entire security model collapses.

According to the EFF's "SSL Observatory," Superfish is not alone.

If you believe Superfish is already on your computer, Lenovo offers this to remove it: http://lnv.gy/17AWJP9. According to the Electronic Frontier Foundation's "Decentralized SSL Obsveratory" database, the certificate's weak password was being actively exploited by a number of illegitimate third parties to intercept traffic between you and Gmail, Amazon, eBay, and other ordinarily secure connections. You can find out more information about the database here: http://bit.ly/SSLEFF.

Making matters worse, VisualDiscovery was apparently not the only program using this flawed certificate. The certificate issuer is a company called Komodia, which also works on the behalf of a few Fortune 500 companies. It's not clear how many of its clients other than Lenovo were using Komodia's self-described "SSL hijacker kit," and it could be none of them. But the possibility is still cause for concern, and the magic number is likely to be higher than zero. **–TM**

> "The certificate's password was being actively exploited by illegitimate third parties.

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FCC TO REGULATE INTERNET

FCC chairman Tom Wheeler led the charge.

BROADBAND INTERNET SERVICE is to be reclassified as a public utility, following a historic vote by the Federal Communications Commission in February, in a move that gives the FCC powers to implement strict net neutrality rules. The new rules were approved in a three-to-two vote, with Democrats voting in favor and Republicans against, and also apply to mobile Internet service. But the war isn't over just yet—opponents are sure to mount a legal challenge. While it's an uphill battle, they may have an easier time convincing courts to issue a stay on the new rules.

Under the approved plan, ISPs will not be allowed to implement paid fast lanes, block access to legal content or services, or throttle speeds unless it's for "reasonable network management," such as upgrades to the infrastructure.

For the better part of the last decade, net neutrality has been an increasingly hot topic, which exploded into the limelight after Netflix and other content providers started revealing network benchmarks that claimed large Internet service providers throttled network speeds for some and not for others—mainly, not for those who were willing to pay higher prices.

The carriers, such as Comcast, TWC, and Verizon, are all claiming the new FCC net neutrality rules based on Title II Regulations will "hurt" and "stifle" Internet innovation for future generations. In fact, Verizon went as far as releasing a press release in Morse code to mock how the FCC is using a dated rule from the 1930s.

Carriers will no doubt take the FCC's ruling to court and attempt to have it modified or thrown out. And for critics claiming the FCC's new net neutrality regulation is a play by the government disguised to fool the average citizen? Verizon's dealt that card already. **–PL & TN**

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MICROSOFT DEVELOPS APPETITE FOR FREEDOM

ON THE HEELS OF ANNOUNCING that Windows 10 would be a free upgrade for the first 12 months of its release to anyone who owns Windows 7, 8, or 8.1, the company announced that it was extending its free Office 365 from just the United States to any eligible student or teacher in the world. Microsoft cited millions of potential new customers from Australia to Germany and Turkey to Hong Kong. They can have access to the latest versions of Word, Excel, PowerPoint, OneNote, Access, and Publisher, all of which can be installed on up to five PCs and five mobile devices. They'll also receive 1TB of storage on OneDrive and access to Office Online for in-browser editing. **–PL**

ANOTHER 840 EVO FIX INCOMING

More problems for the trailblazing SSD

THE SAMSUNG 840 EVO launched to some rave reviews back in 2013, including within these pages. We gave it a 9 Kick-Ass and hailed it as "the fastest SSD we have ever tested by a sizable margin." Unfortunately, some of that luster has since worn off, with a large number of 840 EVO owners reporting a serious decline in read performance of drives with several months' of data on them. The Performance Restoration Software released in October apparently didn't help everyone, so this leaves the South Korean firm with no other choice but to issue another fix, which it says is just around the corner. The company has yet to state the cause of this current problem. **–PC**

Borked again: Samsung 840 EVO

Tech Tragedies and Triumphs

A monthly snapshot of what's up and down in tech

TRIUMPHS

BING AT THE OSCARS
Microsoft's search engine can predict the future. It correctly identified 20 of 24 Oscar winners.

GTX 900M OVERCLOCKING
After removing the feature, Nvidia hears the people and reverses course, allowing owners of its fancy laptop GPUs to overclock their chips.

AD-FREE YOUTUBE
The site is working on a monthly subscription model that would remove ads from videos. It's unclear where that leaves uploaders.

TRAGEDIES

NORTON CRASHES IE
A "corrupt file in the virus definition set" made the 32-bit version of IE unusable, forcing users to uninstall Norton's antivirus software.

WINDOWS XP FEES DOUBLE
Clients using Microsoft's "custom support agreements" discovered the company is quite keen to move them on to actively developed OSes.

EMBEDDED SPYING
Signs point to the NSA installing spyware into the firmware of consumer storage devices.

Tom Halfhill

FAST FORWARD

AMD's Self-Calibrating Microprocessors

FEW PEOPLE CAN MATCH the fast but steady pace of a marathon runner. Experienced athletes pace themselves to run 26.2 miles without collapsing in a mass of cardio overload. They learn their ideal pace by making many practice runs while measuring their performance.

Essentially, they're calibrating themselves to personal variations in strength and stamina, as well as to environmental conditions such as the air temperature, humidity, and terrain.

AMD is bringing a similar technique to microprocessors. Called adaptive voltage/frequency scaling (AVFS), it's one of several new features in the Carrizo family, which supercedes last year's Kaveri family. Designed primarily for low-cost notebook PCs, Carrizo chips are also suitable for compact desktop systems and convertible tablet notebooks.

Carrizo debuts AMD's latest 64-bit CPU core, Excavator, a fourth-gen design to follow Steamroller, Piledriver, and Bulldozer. But it only delivers about 5 percent more performance per clock cycle than Steamroller, so AVFS has more geek appeal.

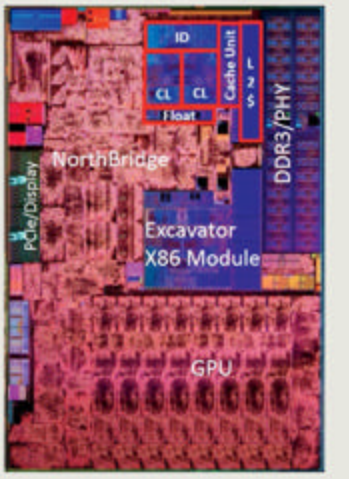
Don't confuse "adaptive" voltage/frequency scaling with "dynamic" scaling. AVFS and DVFS are different techniques, and Carrizo uses both. Dynamic scaling, which has been around since the 1990s, enables a processor to automatically adjust its core voltage and clock frequency to match software workloads. When the workload is less demanding, the chip dials down its voltage and frequency. If it's more demanding, it dials up.

> Just like a marathoner armed with a stopwatch, Carrizo constantly measures its progress, calculates performance, and determines its optimal voltage.

By contrast, adaptive scaling is a self-calibration technique. The processor tests itself to learn how fast it can operate without overloading. It's like overclocking a chip until it fails, then scaling back. But failure is not an option for a consumer processor, so Carrizo has test circuits that duplicate the chip's worst-case circuits—the 500 or so with the longest or most time-critical data paths.

The processor sends test signals along these paths, which have programmable delays. By upping the delays until it fails, Carrizo learns its best performance under existing conditions. And, like a marathoner with a stopwatch, it constantly measures its progress. The processor calculates performance, computes a standard deviation to provide error margins, and determines its optimal voltage and frequency.

Voltage and frequency are vital factors in the power-consumption equation (simplified: P=V^2F). Power equals voltage times frequency, but the voltage factor is squared. That means power consumption rises at a linear rate with clock frequency but soars at a quadratic rate with voltage. So the goal is to keep the chip running at the lowest possible frequency and the lowest possible voltage without slowing the system to a crawl.



AMD's quad-core Carrizo processor self-optimizes its performance.

Adaptive scaling accounts for the manufacturing variations among individual chips, the ambient temperature, and the power supply's voltage swings. Essentially, the processor tunes itself for optimal performance. It can also determine the best range within which dynamic scaling can adjust the voltage and frequency to match varying software workloads. Together, AVFS and DVFS keep the processor running as efficiently as possible.

The benefits are longer battery life and cooler operation—without sacrificing performance when we need it. Although Intel and other companies may be using similar techniques, AMD is the first to disclose the details for a mass-market microprocessor.

Tom Halfhill was formerly a senior editor for *Byte* magazine and is now an analyst for *Microprocessor Report*.

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Dom Reseigh-Lincoln

GAME THEORY

The Love/Hate World of Crowdfunding Games

I'VE HAD SOMETHING OF A DIFFICULT RELATIONSHIP with crowdfunding over the years. I don't dislike it for the nature of its concept, but rather for the grip it's held over the gaming community and how some organizations use it as a way of making a quick buck without the red tape of more traditional funding.

Kickstarter has always felt too easy to abuse and I'm left cold by the idea of paying someone to do their job via current "crowdfunder of the month" Patreon. I've no doubt this Fagin-aping frugalness is part and parcel of me having two kids and a crippling addiction to pro-wrestling and comic books, but there's still something about those two money-grabbing platforms that creeps me out a little. The weird thing is, despite still needing to hand over my cash, the Humble Bundle doesn't evoke the same feeling of powerful dread in me.

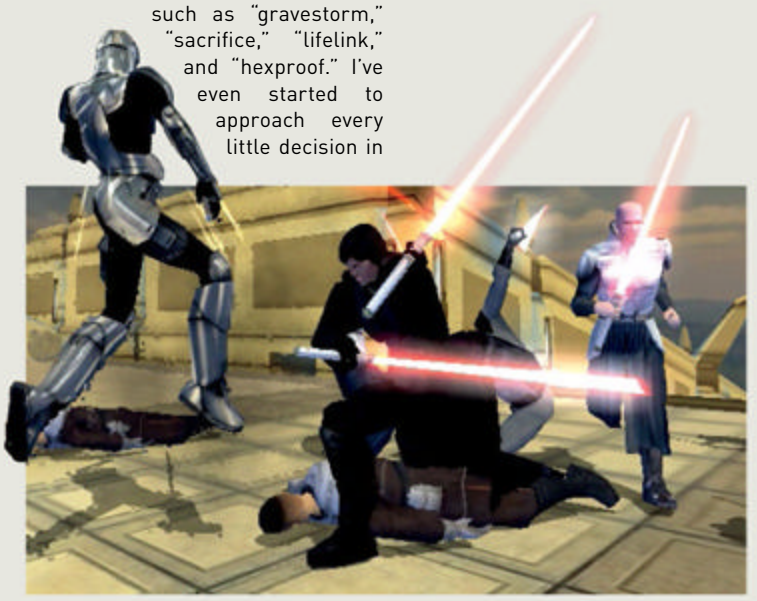
Launched in 2010 (a year after Kickstarter made its own debut), the Humble Bundle is going from strength to strength. Think of it as an ever-changing bunch of DRM-free games and soundtracks that you can pay whatever you want to access. You can even define how much of your donation goes to the developer, how much goes to Humble, and how much is given to charity.

It's a simple setup and is a great way to directly support the developers you love (the initiative has also raised over $50 million for charity over the last five years, so you can't really argue with that). The other month, the Humble Star Wars Bundle made over $1.3 million in less than a day of its launch. Like I said, it's a big deal.

I also hate the Humble Bundle, especially one of its most recent, collectible card-related offerings. Up until I hit that button to pay, card games were a genre I'd barely paid any attention. Then I bought this annoyingly addictive bundle and now I can't stop playing *Scrolls*, *Magic 2015*, and *Star Realms*. My vocabulary has become littered with strange terms such as "gravestorm," "sacrifice," "lifelink," and "hexproof." I've even started to approach every little decision in my life by thinking three moves ahead and checking my hand for a decent spell card to cast. The cards aren't even real! Oh God, this is *Madden*'s Ultimate Team all over again. Please, someone, think of the children...

Dom Reseigh-Lincoln writes for several gaming magazines. When there's no wrestling on the TV.

> I've no doubt that it's part and parcel of having two kids and a crippling addiction to pro-wrestling, but something about those money-grabbing platforms creeps me out a little.



The excellent Humble Star Wars Bundle took $1.3 million in less than a day.

THE LIST

8 AWESOME CO-OP PC GAMES

8

CASTLE CRASHERS Enjoy four-player arcade-style beat 'em ups? You'll love this.

7

BROFORCE Four-player *Contra* meets 80s/90s action movie stars. What's not to love?

6

DIABLO 3 The game is a lot better now than it was at launch. So please, do go to hell.

5

LEFT 4 DEAD 2 This is perhaps the ultimate co-op zombie-killing experience.

4

MINECRAFT Easy to play and fuels your imagination. There's no limit to what you can do.

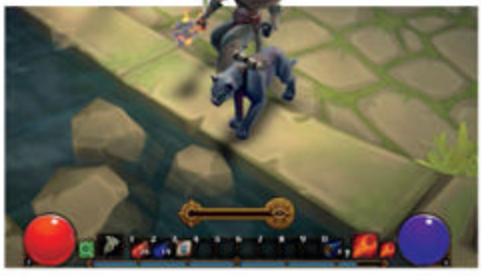
3

ORCS MUST DIE! 2 Set up devilish traps and blast orcs... because, well, orcs must die!

2

PORTAL 2 Valve's brilliant puzzler has its own dedicated two-player campaign, and it's amazing.

1



TORCHLIGHT 2 Looking for a dungeon crawler with pets? This will light up your life.

CyberPower recommends Windows.

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HEAD TO

BY **JIMMY THANG**

Oculus Rift vs. Microsoft HoloLens

Both are head-mounted displays, but is that where the similarity ends? A virtual-reality headset aims to pull you into a fully realized world, but Microsoft says its augmented reality headset is content with keeping you in the real world, just with added holographic goodness. We've had the rare chance of trying out both the HoloLens development kit and Oculus VR's newest Crescent Bay headset. These aren't the final retail versions, but here's how they compare currently.

You'll be more immersed in *Elite: Dangerous* with the Rift, right down to the travel sickness.

HoloLens's mix of the virtual and real worlds will make game development much harder.

ROUND 1

Tech Specs

Both products are at least several months from release. Rumor is that Crescent Bay Rift, which Oculus says is a prototype of what its first consumer version might look like, is using a 2560x1440-resolution panel at 90Hz and with a 100-degree field of view. There's also 3D positional audio that will tie in well to the Rift's excellent stereoscopic 3D visuals. Rift will rely on an external camera for positional head tracking, which Microsoft's HoloLens will not use. And because the Oculus Rift obstructs your view of the "outside world," Oculus maintains that the Rift is intended for seated experiences at the moment.

This isn't the case with HoloLens, however. Because you can see the virtual along with the real, Microsoft is fine with you walking around with the headset on. Microsoft says that the final version will be wireless. Unlike the Oculus Rift, which needs to be plugged into a PC, the HoloLens will be a self-contained computer running Windows 10 with its own CPU, GPU, and a new holographic processing unit (HPU) to tie everything together. HoloLens does have some similarities to the Oculus Rift, however—it will support stereoscopic 3D and have speakers that provide positional audio.

Other HoloLens features include an integrated depth sensor, finger-swiping gesture support, and a built-in mic. Some of that could be coming to the Rift as well, with Oculus recently acquiring camera/hand tracking firm Nimble VR. A big difference between the two headsets in their current states is that the virtual field of view is smaller on Microsoft's headset. There's also no definitive word on how sharp the final HoloLens will be. Microsoft told us "HD," which indicates at least a 720p display. If what we saw is any indication, we'd say it's in good shape. We thought it looked pretty sharp.

Winner:
Too early to predict

ROUND 2

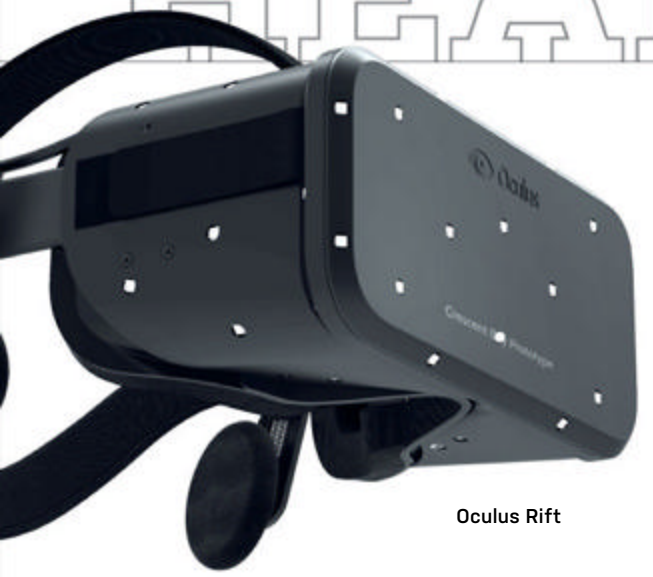
Immersion

Both headsets are trying to sell you on immersion, but which one really nails it? They offer two very different experiences. With the HoloLens, Microsoft isn't trying to shield you from understanding where you are, but it does an excellent job of representing virtual things in your room that aren't really there.

Still, we'd have to give this nod to the Rift, because if it's pulled off correctly, it really convinces you that you're in a different universe altogether. We're confident virtual tourism will work better with the Rift, and that games will also be more intense and scarier with Oculus's offering. When we tried on the Crescent Bay demo at GDC 2014, there was a demo where we saw a giant T-Rex approach us and it felt like it could really bite our heads off (à la *Jurassic Park* lawyer scene) if he really wanted to. It was kind of unsettling. Plus, the Rift currently offers a more encompassing field of view.

Winner:
Oculus Rift

HEAD



Oculus Rift

Microsoft HoloLens

ROUND 3

Productivity

With Facebook buying Oculus for two billion dollars, we're sure social media, video chat, and such will be big components for the Rift. But you can see the virtual with the real with Microsoft's solution, so we're picking HoloLens for productivity potential.

At January's press event, we were asked to put on HoloLens and fix an electrical socket with real tools. Using Skype, the person on the other end could see what we we were seeing and draw on their touchscreen to offer advice. We can see this being used to fix cars and can easily imagine HoloLens being used in the ER.

We also know HoloLens will support finger gestures. This will allow you to use MS's HoloStudio to make 3D objects, and send them to a 3D printer. Microsoft says it's the best print preview for 3D printing out there. With HoloLens, the lines between the real and digital will become blurrier.

Winner: HoloLens

ROUND 4

Gaming

Lots of traditional first-person games are being ported over to the Rift, but Oculus says the best VR games will have to be tailor-made. That's because locomotion—the queasiness from when your eyes think your body is moving but your brain does not—is still an issue. And there isn't yet a silver bullet controller to solve that problem.

There are more questions for gaming on HoloLens. We could see I-spy games being really popular, and FPS games that have us blasting aliens that come in from the kitchen. But from the information we have, it seems much easier to program games for Oculus, since developers won't have to deal with real-world variances. The HoloLens does have mobility going for it, though, and this could open up new gameplay opportunities. While we're confident some cool casual games could come out of this, we reckon the bigger AAA games will be on Oculus.

Winner: Oculus Rift

ROUND 5

Entertainment

With VR documentaries already announced, including one from legendary nature documentary producer David Attenborough, it's going to be tough to beat the Rift here. Who knows, VR and not 3D could turn out to be the next big thing in video. So we expect to see a whole new class of TV and movies created for VR. Plus, much of the porn industry is also, ahem, behind VR as well, so there's that...

On the other hand, HoloLens could be used with existing display technology to, yup, you guessed it, augment entertainment content. The possibilities here are pretty extensive, and augmented entertainment that allows you to still see what's going on around you may be more attractive to mainstream audiences. But it's the kind of theory that may not translate to practice. We think the wider viewing angle and all-encompassing approach that Oculus brings help it trump HoloLens, at least for now.

Winner: Oculus Rift

And the Winner Is...

Oculus won three out of the five categories here, but really, the two devices aim to serve different purposes. Is there room for both headsets? Only time will tell. Perhaps one day we might see an amalgamation headset that combines elements of VR and AR. Conversely, both of these headsets still have a lot to prove and if they aren't executed well, both could become shovelware.

For now, we'd have to give Oculus Rift the advantage. People can relate more easily to the idea of VR. And with Oculus VR doing a really good job embracing the open-source community, there are currently more developers working with the Rift headset.

DOCTOR

THIS MONTH THE DOCTOR TACKLES...

> Multi-GPU Setups
> Hard Drive Fears
> Cooling Cores

Feeling The Heat

I've been a PC gamer since 1998 and a reader of *Maximum PC* for almost 10 years. I recently built my own system, mimicking the Turbo build in your February 2015 issue. It was easier than I could've ever imagined, and much faster than the heavily upgraded Alienware Aurora I bought in 2008. My Core i7-5820K and dual GTX 970 Gaming 4G LE cards are a perfect combo for the MSI X99S SLI Plus mobo with 16GB of G.Skill DDR4 SDRAM. Everything is great except for the heat that the second 970 cannot dissipate. I packed all of my goodies in a Rosewill Gaming ATX full-tower case and added an extra Noctua 120mm fan on the bottom for added air flow. Without overclocking, and with all the case fans running at 100 percent, GPU number two gets up to 91 degrees Celsius. I know why it's running hot. There's little room between the cards. What else can I do besides water cooling to keep the temps down?

–Ssgt_Frag_Factor

THE DOCTOR RESPONDS: Welcome to the world of multi-GPU troubleshooting, staff sergeant. Two GTX 970s become an incredibly powerful force... when they're working together harmoniously. But a number of factors can affect an SLI- or CrossFire-equipped platform, from hardware considerations to more complicated software issues.

Axial-flow fans like the ones on your MSI cards are exceedingly popular because they're quiet. They also exhaust all of their waste heat back into your case, though. That's why the Doc favors centrifugal fans, which draw air in and typically push it out vents in the rear I/O bracket. Compounding the problem, your bottom card has very little room to "breathe," and the air it's pulling in through that narrow slit is already warm. Because MSI's X99S SLI Plus won't let you relocate either 970—they have to live in PCI_E1 and PCI_E3—so you're stuck with the physical arrangement you're currently using.

Armed with the knowledge that two high-end GPUs are heating up your PC's internals, optimizing airflow becomes the priority. You mentioned case fans running at full-speed—but what direction are they pointing? Create a front-to-back stream with intake fans up front and exhaust in the back. And experiment with custom fan profiles for your graphics cards using MSI's Afterburner software, spinning them up at lower temperatures. You could always try underclocking and undervolting as well. Both techniques (especially combined) will limit the heat those cards put out.

ASRock's X99 Extreme4 lets you install two double-slot graphics cards with an extra space between them.

Unfortunately, your bottom board's cooling issues are almost assuredly affecting its maximum GPU Boost frequency, robbing you of some performance. That's not an easy conundrum to solve given your components. But the symptoms can be mitigated. The best way for others to combat this is by choosing a mobo with one extra space between PCIe slots designated for graphics (ASRock's X99 Extreme4 is one example) and videocards that dump hot air outside of the case.

Time To Upgrade?

Doc, I've some extra cash and have been thinking about getting a Radeon R9 270X to pair with my 7870 GHz Edition. The Internet is fraught with threads on CrossFire issues, but I thought there was a driver update a while back that significantly improved the situation, in addition to the Omega driver's features. It seems a 270X would be a relatively cheap upgrade for what could be a healthy performance boost. Also, since the 270X has faster memory, should I overclock the 7870 to match or leave everything alone? What would the Doc recommend? My system's specs include Windows 7, a Core i5-3570K, MSI's Z77A-GD65, a Gigabyte 7870 GHz Edition card, 8GB of DDR3, and a 750W Corsair PSU.

–Daniel Hill

THE DOCTOR RESPONDS: I'm going to share a secret, Daniel. But first let's do some math. An R9 270X with 2GB of GDDR5 sells for $175 on Newegg. A Radeon HD 7870 GHz Edition fetches $100 to $120 on Ebay. So, you could spend $175 and build a sweet dual-card Pitcairn/Curaçao-based array. Or, you could sell the 7870, add it to your new-card budget, and snag an R9 290 with 4GB.

↘ submit your questions to: doctor@maximumpc.com

Now, the secret: the Doc's lab is equipped with some very sophisticated testing equipment, which has uncovered many multi-GPU issues over the years, most involving CrossFire. To AMD's credit, its drivers are far better now than at any time in the past. The company listened to its customers and added features like frame pacing to smooth the rate at which content is displayed on-screen. But CrossFire is a moving target, requiring profiles for new games and optimizations for new platforms, on top of the development that goes into addressing the technology's other challenges.

Whenever the Doc can, he favors single-GPU setups to circumvent all of that. The two cards you're considering in CrossFire will almost certainly be faster than an R9 290 in measures of average frame rate. They'll also consume more power, generate more heat, occupy more space on your motherboard, and create more noise. Don't forget to consider memory! At resolutions up to 1920x1080, 2GB is appropriate. Should you wish to game on a QHD or 4K monitor, though, stepping up to 4GB makes sense. The same goes for Eyefinity setups.

At least in the Doc's opinion, multi-GPU configs appeal to enthusiasts who can't get enough speed from one card. You expect to weather occasional hiccups in the name of unmatched performance. Bargains do abound for mainstream gamers combining the muscle of capable graphics processors. The GeForce GTX 460 was notoriously attractive in SLI, for example. You'll make certain compromises in the process though, and sometimes it's more fun to simply enjoy a trouble-free experience on the day a game launches.

Unhealthy Hard Drive

Whenever my hard disk is active, it starts buzzing. I'm thinking that it's going to go kaput soon. I performed a CHKDSK, but the system does not report anything adverse, saying my drives are healthy. This is an old computer (Windows XP), but I don't have the money to purchase a newer system at this time. However, I might be able to afford a new hard disk and transfer everything to that media. Or should I buy a hard disk for the box I already have? Does the buzzing mean that the current hard drive is going to take a permanent vacation?

–Eric Caruso

Deepcool manufactures an enclosure that not only minimizes vibration, but also keeps your 3.5-inch hard drive running cool.

THE DOCTOR RESPONDS: The Doc maintains a multi-disk network-attached appliance with all of his important files, so he's all too familiar with the sounds mechanical drives can make when they're about to become doorstops. Forgive the seemingly silly question, but are you certain the noise is coming from within the hard drive, and not some piece of your chassis around it?

You already know that hard disks employ platters spinning very, very quickly. They accelerate, they decelerate, and the read/write heads dart around in there, too. All of this creates vibration, which is most pronounced when the drive is active. And if your disk isn't properly isolated from the case holding it in place, those vibrations can turn into a high-frequency buzz. They can also negatively affect storage performance or even cause I/O errors. Depending how your hard drive is mounted in your chassis, consider installing rubber grommets to better-isolate the disk from its cage.

If the issue really is internal, then the noise you're describing might best be described as a chatter, and it indeed precedes (or is accompanied by) failure. In either case, save your personal data to an optical disc, thumb drive, or cloud-based service right away. Google will give you 15GB for free through its Drive service. Whether your hard drive is healthy or not, the Doc gets the sense you may not have your important information protected against an unforeseen disaster.

With that said, in the Doc's opinion, an inexpensive hard drive replacement is always worthwhile, even for an old PC, if it keeps that machine running until you can upgrade to something quicker.

Working Your Cores

My CPU is an AMD Athlon II X3 455. After I got it a few years ago, I was able to unlock the die's fourth core. Problem is, with the forth core enabled, my temps skyrocket, and undervolting even to the point of instability isn't helping at stock speeds. It was running at 65 degrees at full load originally, which I didn't worry about because it was never at 100 percent utilization.

But now I want it to fold 24/7 and the temps are up to 69 degrees at full load. That's 18 degrees higher than when it was a triple-core config. I don't plan on overclocking with my current board, so I'm not sure if I should just reseat it with some AS5 or just bite the bullet and buy a cooler I can take to another system down the road. What do you think?

–James Lloyd

THE DOCTOR RESPONDS: The Doc remembers fondly going through his first tray of Phenom II X4 and Phenom II X2 CPUs, checking to see which Deneb-based dies ran stably with additional cores or cache switched on. AMD never made it clear how many of its cut-down models suffered imperfect silicon, or if it remarked processors from higher-end bins to meet market demand for the cheaper parts.

We do know from testing that a great many of the deliberately handicapped chips only worked with certain on-die resources disabled. Those that could be enhanced in some way often demonstrated other strange behaviors—inexplicable crashes, for example, or abnormally high temperatures like you're seeing.

That your Rana-based Athlon II X3 still operates with all of its cores enabled is definitely cool (and quite a testament to the value of those CPUs). But the Doc wouldn't recommend spending money chasing rising temperatures. A beefier heatsink may help in the short-term, but the phenomenon you're describing will only worsen over time. And by then, even a three-core config could be dicey. Now's the time to go easy on this aging component until it can be replaced.

Sure, if you've some thermal paste handy, feel free to pop your sink and reapply. Cleaning off a crusty old layer could help bring your peak temps down a bit. But then think about dialing back to three cores until it's time to upgrade. An affordable Pentium G3258 or Athlon X4 760K would give you a lot more speed, and a modern graphics card—even a mainstream one—would augment your folding performance far more than that one missing core.

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8278-S

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- 8GB DDR3-1600MHz Memory
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- 1TB 7200RPM SATA II Hard Drive
- 6X Blu-ray Reader / 8X DVD±R/2.4X +DL Super Multi Drive
- 2 Hard Drives + 2 mSATA SSD Drives Capable with Raid 0, 1 Function
- Full sized Keyboard with color LED backlight
- Intel® Dual Band Wireless-AC 7260 Wireless LAN + Bluetooth Wireless Combo
- Built-in Card Reader, Fingerprint Reader and 2.0M FHD Video Camera
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R.A.T. TE

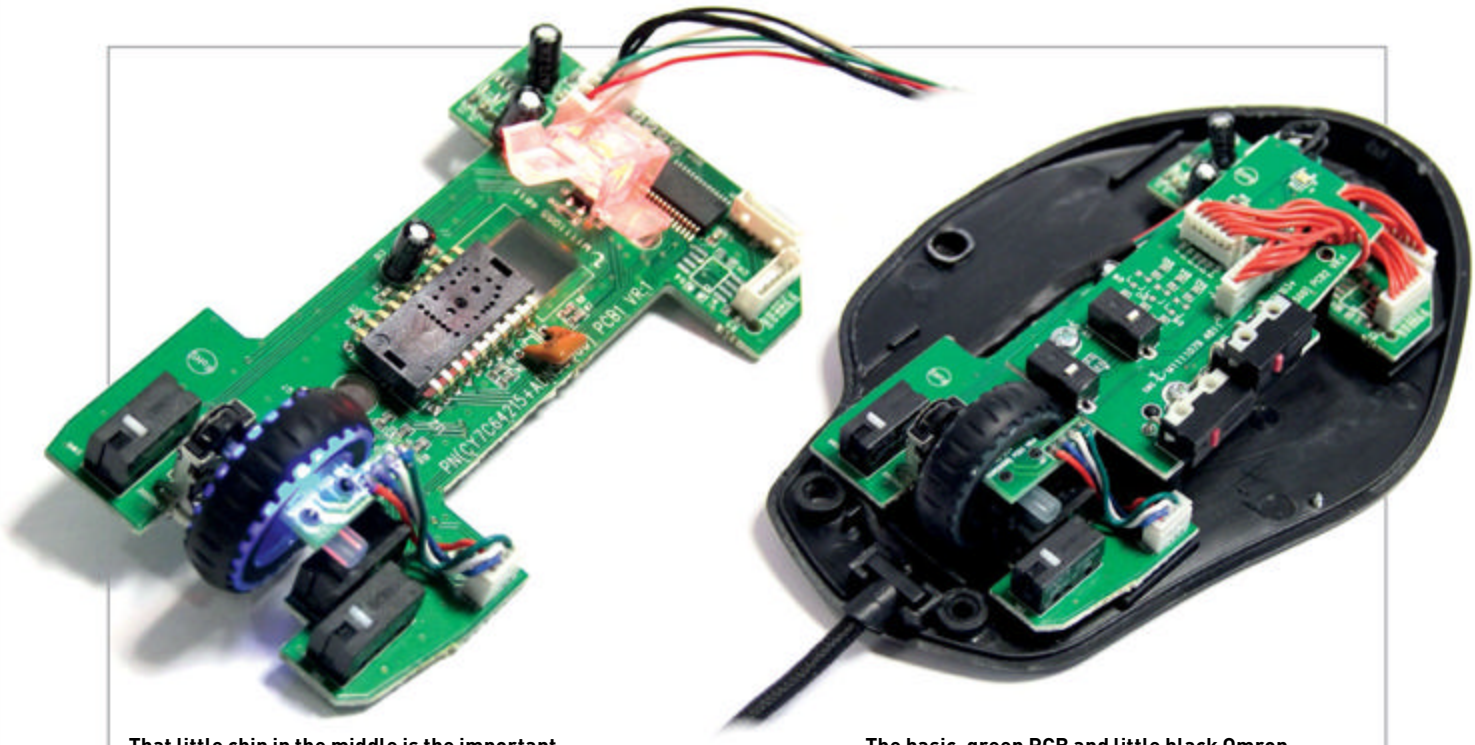
THE GREAT MOUSE COLLECTIVE

A whole heap of gaming rodents, dissected, investigated, and served up for your pleasure

THE HUMBLE COMPUTER MOUSE has a reputation for being dull. It's got a couple of buttons, a wheel, it might be wireless but if it is then sometimes it doesn't work. It's perfectly happy with a USB 2.0 port, maybe one on a keyboard hub that doesn't give out much power. In conclusion: mice are boring. Any old one will do as long as it moves the pointer. Now go worry about whether you want blue case lights or green.

But *Maximum PC* says no! Mice are exciting! They'll put a panic in your pulse and leave your house in ruin too if you're not careful. They'll rampage across your desk and have you issuing commands faster than you ever previously could. Well, maybe. Before we descend completely into the kind of marketing nonsense you might get from a peripheral manufacturer, let's get on with the testing...

This is a supertest of gaming mice. They're not out to change the world, but they are hoping to make you slightly better at games by lowering your response times, increasing the amount of screen real estate you can cover with a single flick of the wrist, and upping your accuracy.



That little chip in the middle is the important bit—the laser sensor. The red bit is the laser...

The basic, green PCB and little black Omron switches look rather flimsy under the mouse skin.

All the mice we're featuring here have adjustable sensitivity, most of them have programmable buttons, and, often, absolutely pointless colored lighting systems. Many have sniper buttons, which lower sensitivity—so that while drawing a bead on an enemy's head with a sniper rifle, you wobble around as little as possible. Many also have multiple buttons that can have commands assigned to them. Some have memory onboard to store multiple profiles, too. Once a simple rolling ball enclosure that moved a pointer, mice are now packed with technology. A few even sport their own CPUs.

You'll have seen us review a few of them before. We've included them again as a supertest demands comparing the best on the market, not just what we haven't seen before. Technology advances, price changes, and new releases inevitably lead to fresh opinions on existing products.

GETTING HANDS-ON

There are two strains of mouse user. There are the palmers, who lay their hands flat, their fingers draped languorously over the buttons like Jessica Rabbit sunbathing. And the claw-grippers, who approach their mouse like an *Alien* face-hugger.

Palmers don't use their fingertips, but rather the pads, sacrificing a small amount of responsiveness and accuracy for comfort and endurance. Claw-grippers can build up strain in the fingers if their mouse isn't the right shape for their hand, but there's no one faster to get the pointer across the screen or the finger on the right button.

Palmers often prefer a larger mouse with plenty of contact between the back of the body and their sweaty hand-slab, while a mouse designed for a claw-gripper will be smaller and lower to accommodate the fingertips. The claw-gripper's palm may never even touch the back of the mouse, unless they're using it to slog away in Excel for an afternoon. After all, even the greatest *Arma* sniper gotta get paid.

Likewise, there are two major types of sensor in mice these days—the laser and the optical. Not one mouse in this test has the old-fashioned rolling ball underneath. We can't even remember when we last saw one. The design had several in-built flaws, not least its tendency to pick up dirt.

Do you want a heavy mouse or a lightweight, flyaway rodent?

This grime was collected by the ball but almost always passed on to the rollers that detected the ball's movement, lowering their sensitivity to such an extent that the pointer didn't move at all, meaning the ball then had to be removed so the rollers could be cleaned. This often meant unbending paper clips or using some other sharp object, which inevitably left scratches that could collect dirt... and round and round we went. Much like a ball in a mouse.

Playing any sort of fast-paced game with a mechanical mouse—at least as far back as the original *Quake*—was unsatisfying. Games have changed as well, of course, with an increase in the real-time elements that necessitate fast pointer movements. We wouldn't want to play a modern FPS with a rolling ball under our hand, but remember trying to play *Doom* and *Wing Commander* with one. Games back then weren't built with the kind of mouse controls we have in mind today.

OPTICAL EXPRESS

Thanks to the optical mouse, we don't have to. Through the use of a camera-like device, known as an electro-optical sensor, they keep track of the surface they're being moved across without having

The Future of War?

How will you be controlling your gaming PC in the future? Touch, gesture, thought control?

With Microsoft's Kinect and Intel's RealSense, gesture could be the future.

Despite what some companies might have us believe, the mouse does not seem to be threatened by the flood of touchscreen devices. Our PCs are not tablets or phones, and while a touchscreen laptop is fun for five minutes, its usefulness outside Windows 8's interface-formerly-known-as-Metro is questionable.

That goes doubly for games. Anyone who's ever played games using a laptop's trackpad will know that it's fine for a quick blast of something turn-based, but its lack of space, responsiveness, and sensitivity soon leads to frustration in anything that requires actual reflexes.

The future could be very different, however, as motion detection is on the rise. There's the Leap Controller, a fancy webcam that tracks your finger movements; Microsoft's Kinect Xbox controller, which tracks you dancing around your living room; and the Haptix, a project funded through Kickstarter that looks very much like *Wall-E*'s webcam and turns any flat surface into a 3D multitouch controller.

Haptix looks a bit like you're controlling your PC with a large invisible iPad, and a startup called DexType is using the technology to create invisible keyboards too. This sounds like a recipe for disaster, but relies on a form of typing that condenses the alphabet down to 10 letters and uses finger combinations to make the rest—it only matters which fingers are pressed down, not where they're pressed.

So now we've killed off both the mouse and the keyboard, where does that leave us? Well, for the time being, things are probably not going to radically change. The superiority of mouse and keyboard controls has long been an argument against letting console and PC gamers play together online, but with the rise of VR (and better controllers), PC players are more often using console-like control schemes.

So the future could bring a leveled playing field, even if it does mean the death of the mouse as we know it today.

Sixense's Stem system could be the perfect VR controller system.

to be in physical contact with it. The base of the mouse usually is, however, and manufacturers go to great pains to make sure their mice have "feet" that will glide across a desk smoothly.

The optical mouse dates back to 1980, when MIT and Xerox independently came up with designs. The MIT mouse would perhaps be familiar today, with an infrared LED as a light source, but needed grid lines drawn on to a mouse pad in special ink to work. No slamming it straight against the desk surface there. Xerox's invention has its modern counterpart in the Fusion Engine used in some Logitech mice, with its melding of a light sensor and motion detection. Xerox too used a special pad, this time with colored dots on it.

It took until 1999 for optical mice to hit the mainstream, with Microsoft's use of HP tech in the Intellimouse Explorer. The Intellimouse brand had been around for a couple of years as a mechanical mouse, and we've got MS to thank for introducing other features we take as standard today, such as extra buttons and scroll wheels.

Since then, improved manufacturing processes have made it possible to fit more and more processing power into smaller and smaller spaces. Some of the mice we've tested here sport discrete 32-bit ARM processors, and still find room for weighting systems and pockets of fresh air.

IN YOUR SIGHTS

Laser mice are a subspecies of optical mice that sound a lot more exciting than they actually are. Something has to illuminate the surface under a mouse for the surface tracking to work, and in most optical mice it's an LED just like in Christmas tree lights. They're commonly red, as these were the first LEDs developed and therefore the cheapest, but any color will work. Laser mice build on this by using an infrared laser LED, broadly similar to the one in your DVD drive. Sadly, as much as we may have fantasized about it, you're not going to be able to shoot your boss in the neck from across the office, causing a self-cauterizing wound and doing irreparable nerve damage, with a laser mouse. Some people think about this too much. [Yes, it seems they do—Ed.]

The laser illumination increases the resolution of the tracking sensor, leading to increased accuracy of movement translated to the pointer. In the real world, you're unlikely to notice a difference between an optical and laser mouse unless you live somewhere made entirely of glass (in which case we have questions for you about the plumbing), as laser mice can track transparent surfaces an optical mouse would give up on.

It's those real-world needs that should be foremost in your mind when choosing a gaming mouse. Do you need 90 programmable functions? Does the weight balance in your current mouse drive you so wild that you pace the floors at night wishing you could alter it? Would the ability to map commands to mouse buttons make you a better gamer, or can you just use the keyboard commands? After all, you've still got to remember them, wherever they are.

You can spend a lot on a mouse. But as we'll see, if you don't need the advanced features, you can still get a hell of a lot of rodent for a bargain price. –IAN EVENDEN

> “Mice are now being packed with technology. Some sport discrete 32-bit ARM processors.

It may look like an ugly lump of black plastic, but this is a finely tuned, and tunable, gaming mouse.

LOGITECH G502 PROTEUS CORE

Is that the best you've got, Logitech? Well, yes...

LEAVING ASIDE THE ABSURD NAME, which sounds like something from console shooter *Destiny*, that PC gamers would know nothing about, the G502 is an excellent mouse. Unlike the Sharkoon Fireglider that follows, this should come as no surprise. It's Logitech's current top-of-the-range gaming mouse and has had bells, whistles, and attention lavished on it.

The one thing its smart design is missing is an extendable body; for those of us with bear paws it comes up a little short. There's a prescribed place for your thumb on the left, on a ledge just behind the sniper key and below two of the programmable buttons, and any movement from this area renders them unpressable. It's designed with the claw-gripper in mind, but is perfectly usable by a palmer as long as you're not expecting remarkable length.

In use, and as long as you keep your thumb in the right place, the G502 reflects its range-topping status. The bog-standard plastic finish is enlivened with a little grip-enhancing texturing. The mouse is held above the desktop on six oddly shaped feet, and in our tests slid cleanly across a variety of surfaces—which also gave us a chance to try out the Logitech Gaming Software, that claims to calibrate your mouse so every surface glides past like velvet smeared with Vaseline. It seemed to cope well with our desk, last cleaned in about 2008.

Button placement is excellent, though with the proviso about your thumb once again. If you're a massive clumsy idiot, there's a small chance you could knock the buttons near the main left clicker when the red mists of gun-fury take over, but *Maximum PC*'s official massive clumsy idiot seemed to have no problems when we taped the mouse to his hand and explained patiently what we wanted him to do.

THE WHEEL DEAL

The buttons are a little disappointing in terms of travel though—we much prefer to feel the button go down and depress the switch rather than relying on screen feedback, and the G502 doesn't manage more than an anemic "snick" from most of its switches. There is one glorious exception to this: the button that switches the wheel between free-spinning and sectioned resistance modes is truly brilliant. So satisfying in fact that it elicited a cry of joy that caused heads to turn, even in an office used to such ejaculations. It led to us scrolling through our Steam library hunting for a game that would need the switch to be pressed frequently.

Ridiculous behavior? Perhaps, but a good wheel is something that endears us to a mouse. And the G502's has a trick up its sleeve, tilting left and right for scrolling that's especially useful for moving the camera around an RTS battlefield (or reading a web page). As a result of all this wheel-based fun it can feel a little like having your finger suspended in the interior of a Dalek, all switches and probes and electronic sensors.

The mouse's headline feature is an insanely high sensitivity of 12,000dpi. Just because you can do this doesn't mean you should, and it proves far too sensitive for any use. Maybe a *Starcraft II* savant with a 4K screen might get some use out of it, but for the likes of us it becomes a game of spot-the-pointer all too quickly.

This is a mouse that deserves its place at the top of Logitech's range, and while not exactly a budget model, we'd take it over more expensive rivals.

SPECIFICATIONS

Sensor	Optical
Max sensitivity	12,000dpi
Programmable buttons	11

VERDICT 9

Logitech G502 Proteus Core

CORE Clean movement; clever Fusion Engine; great wheel.

CHORE Lacks an extendable body; buttons could be better.

$68, www.logitech.com

The what? By who? For how much? Yeah, we'd never heard of it either.

SHARKOON FIREGLIDER

Super-cheap gaming mouse turns out golden

FIREGLIDER. FIRE. GLIDER. That's a good name, isn't it? Two things a mouse should do, firing and gliding, together at last. You can find this mouse for just over $20 online, and despite being decked out with the kind of art more usually seen tattooed on the biceps of the guy at the gym who doesn't wipe down the machines or put the weights away properly, this was—much to our surprise—a comfortable and satisfying mouse to use.

The length of the body isn't adjustable, so maybe it comes down to having the kind of hands more often seen gripping cage bars at the zoo, but this long, high-set mouse fits perfectly in our palm. With a shape much like that of Marilyn Monroe during her time playing defensive tackle for the Patriots, the third finger slides perfectly along the shoulder created by the right-hand button to grip the body by its waist.

On the left, a soft rubber pad is ribbed for your pleasure, looking not unlike the swaying gills of a fungus, and provides somewhere for your thumb to sit, the two side buttons positioned just above it. One of these buttons is textured, the other smooth, adding an extra layer of tactility to differentiate between them when groping blindly while firing and gliding.

The main buttons are well designed as well, smooth but broad and with raised edges to keep your fingers in place. The additional button near the wheel has a textured top, and pressing it takes an easy hop of the finger.

The textured surfaces make such a contrast because the rest of the mouse's body is so smooth. Its matte black plastic offers no grippy coating and it's perfectly possible to slide your fingers off any of its body surfaces. This doesn't happen during use, the rampant rubber on the left, and the size and shape of the body keeping it secure. Oddly, the base plate looks as if it does have a texture, right where you wouldn't want it, but this is raised slightly from the desktop and makes no difference to its gliding.

SOME LIKE IT HOT

The texturing seems to be there purely to facilitate the opening of the weights door. Seven bits of metal are arranged in something like a revolver's cylinder, and can be added and removed to adjust mass and balance.

There really isn't all that much difference between having them all in or all out, however, and the Fireglider could have done away with this feature and knocked another buck off the price. But marketing boxes need to be ticked. And while this isn't an ambidextrous mouse, the 10 percent of us out there with the higher risk of psychiatric disorders could use it, at a pinch, without too much trouble.

The Fireglider is meant to be a budget model, but punches enough above its weight to have almost ended up at the top of our supertest. Picking between this and the Logitech G502 is like choosing which Chippendale you'd most like to oil up: it's ultimately down to the shape of your hands and how you like to grip. The Fireglider, with its length and height, is a palmer's mouse, while the G502 is ambi-grippable, but repays the claw-gripper more. Then there's price, of course, with the Logitech costing about three times as much.

Buying a cheap mouse is always going to contain a slight element of risk. You never know what corners have been cut in terms of switches or sensors, but when a cheap mouse is as nicely designed as this, even a short time spent firing and gliding together is worth the money.

SPECIFICATIONS

Sensor	Laser
Max sensitivity	3,600dpi
Programmable buttons	Six

VERDICT 8

Sharkoon Fireglider

FIRE Really great value.

DIRE Buy cheap, buy twice?

$23, www.sharkoon.com

ELEMENT IRIDIUM 820

Repeat after us: basic design is important

THERE ARE SOME THINGS that feel like they're meant to be in your hand. The brass handle of a local bar, worn smooth by generations of feckless layabouts. The leather-bound grip of a favored dagger. Certain parts of someone else's lover. And then there's the Element Iridium.

It ticks all the boxes. The body length can be adjusted. There are programmable buttons. You can fiddle with the light it emits. And there's a weighting system. The Iridium wants you to like it so much. But there's a problem—all its jazzy trimmings are attached to a poorly designed body with a strange hump protruding from the right, forcing you to readjust your grip. It's a baffling inclusion, only becoming close to comfortable if you put your middle and ring fingers either side of it, leaving your index finger to work all the buttons. A claw grip with the hump between ring and little fingertips seems the best compromise.

A large bolt that screws into the back of the body controls the mouse's length. Unscrewing it extends the rear panel like an aftermarket spoiler on the back of a Honda Civic, two springs making sure both sides extend evenly. The weighting system is nuts—literally. A small cartridge holds four nuts that the extension bolt screws through, but both they and the bolt are so slight that they make no difference to the feel of the mouse whatsoever.

As for the buttons, well, they work and don't feel like they're in imminent danger of falling off. Palmers may find their hand is too far forward on the body to easily press the side or extra top buttons.

Still, it's not all bad. More mice should have a button marked "attack." You know where you are with such straightforward labeling. That's it though. We used this mouse for a morning before getting utterly fed up with it.

SPECIFICATIONS

Sensor	Laser
Max sensitivity	8,200dpi
Programmable buttons	Eight

VERDICT 3

Element Iridium 820

ELEMENT Works; succeeds in not falling apart.

REDOLENT Everything else about it.

$46, www.elementgaming.com

MAD CATZ R.A.T TE

Lightness is a virtue, but not the only one

THE R.A.T'S SHAPE is strongly reminiscent of the hand of Lex, protagonist of Origin's 1995 game *Bioforge*, that's so nicely picked out in green in the box art. (For those of you somehow not familiar with a 20-year-old DOS game that didn't sell spectacularly well, it'll run in Dosbox and is an interesting document of the exact point that 3D graphics came faltering and glitching over the hill, with quite a lot in common with the original *Resident Evil* and... well, you'll see, we better get back to the mouse.)

The other thing it has in common with Lex is that its casing seems to be coming apart and large parts of its innards are visible. It's all very impressive to look at, but does it do anything when you actually use the thing?

The body of the mouse is quite broad—we're not sure we'd want to find anything broader, although in the Element Iridium 820, we did—and sits reasonably low and flat. You can alter its length by pressing a spring-loaded switch at the back. Its shape is an interesting experiment in how far you can warp the form of a mouse and still have it remain recognizably a mouse. There's a lot of empty space inside its body, just as there is inside the head of the person who decided to make it entirely from plastic.

It's too light, and feels flimsy. For all of its nice touches, such as the shelf that extends from the left to cradle your thumb and keep it at the right height for the nearby buttons, it's the only mouse we've come across that's crying out for one of those weighting systems so popular with the young people these days. A few pellets of depleted uranium inserted where the sun don't shine might give it a bit more presence.

The manufacturer actually makes a point of its lightness in its sales pitch, but pick up a R.A.T 7 after a session with the TE and you'll be left with no doubt about which is the higher quality product.

SPECIFICATIONS

Sensor	Laser
Max sensitivity	8,200dpi
Programmable buttons	Nine

VERDICT 5

Mad Catz R.A.T TE

RATTY Distinctive look; fast; decent accuracy.

TATTY So light it's insubstantial.

$60, www.madcatz.com

COOLERMASTER REAPER

Proof, if needed, that metal will never die

AN ALUMINUM GAMING MOUSE! That's what the box says. How wonderful! It'll come out of the packet all shiny and cool, and will need gloves to handle in winter and... oh. It's not an aluminum gaming mouse. It's a plastic gaming mouse made from the same old soft-touch matte-black stuff, with a shiny aluminum panel on the back where it meets your palm.

Under your hand, the aluminum panel feels cool at first but soon warms up to ambient temperature. Sadly there's no active liquid cooling going on inside. Beneath the mouse there's a recessed nut that can be undone to remove and replace the aluminum panel. Replace with what though? It's described as "customizable" by the manufacturer, and maybe that means you can paint it and put it back on, but there are only aluminum replacements available on the CoolerMaster online store. A shame, as we fancied a gold one.

The wheel is metal too, and is a lovely thing to contentedly twiddle with. Your finger will glide over it all graceful at first, but apply a modicum of pressure and the heavy wheel begins to turn most satisfyingly, each notch choonking into place unambiguously. The other switches, unfortunately, are a bit more forgettable. The best of them is the large "clutch" button at the front of the thumb area—it's nice to feel a great big one occasionally, rather than the tiny and hard-to-find switches that are all over most gaming mice.

The rest of the Reaper's operation is decidedly average too. It's a terrible thing to say of a product that it's merely "fine," but the Reaper is just that and nothing more. It fulfils all its functions with no great panache or excitement apart from the notable exceptions of a genuinely excellent wheel and a gradually warming cold patch sat on its back.

SPECIFICATIONS

Sensor	Laser
Max sensitivity	8,200dpi
Programmable buttons	Eight

VERDICT 5

CoolerMaster Reaper

REAPER Excellent wheel; big switches.

CREEPER The rest is merely average.

$60, www.coolermaster.com

MAD CATZ R.A.T 7 MMO

The most loco mouse on the market

THE RADIATION-GORGED MUTANT of the Mad Catz family sprouts so many things to press and fiddle with that it could probably keep a sensory class full of toddlers entertained all day. We half expected it to start playing the theme tune to *SpongeBob SquarePants* any moment. It shares the same basic shape—and therefore the same criticisms—as the Tournament Edition, but the MMO's improved build and weight mark it out as the superior product.

Using the spring-loaded lever to adjust the length is more important with this mouse than perhaps any other we've put to the test, as the position of the player's thumb really does matter. Five buttons and a mini-joystick are positioned around it, and having the opposable digit extended too far can really be disastrous, as a missed button means a missed spell or attack, or even worse, a sickening few seconds spent having to actually look at the mouse itself.

Look at it you will in the first days of ownership. The bright red and black model provided to us for review is a beautiful, striking thing that attracts admiration and comment, whether it's sat on a desk or we're sitting stroking it on the bus.

While we're normally suckers for anything you can adjust with an Allen key—and there's one cleverly tucked away up this mouse's ass, ready to make adjustments a simple thumbscrew could probably have coped with—the MMO suffers from being too complex. If you're not going to use its 15 programmable buttons, and memorize the functions you've assigned to each through three modes and a shift key, then it's just overkill. It will ultimately frustrate more often than it will delight.

The Tournament Edition isn't enough. But then the MMO is too much. You'd be better off looking to the bog-standard R.A.T 7 for the Goldilocks zone of this range.

SPECIFICATIONS

Sensor	Laser
Max sensitivity	6,400dpi
Programmable buttons	15 with four modes

VERDICT 8

Mad Catz R.A.T 7 MMO

HEAVEN Perfect if you like to fiddle; good build quality.

HEATHEN Too much if you just want to play.

$125, www.madcatz.com

LOGITECH G402 HYPERION FURY

A mouse for the quick-wristed

THOSE DEMONIC FLESH-MELDING wizards at Logitech have taken it too far this time, transplanting the brain from an old Raspberry Pi (or low-end mobile phone) into a mouse. Freed from the need to constantly check Facebook or stream episodes of *My Little Pony: Friendship is Magic*, the 32-bit ARM core here monitors a gyroscope and accelerometer combo that the manufacturer lovingly refers to as a Fusion Engine.

Sadly, there's no magnetically confined plasma here. What you do get, however, is a claimed tracking speed of 500IPS (inches per second). That's 12.7 metres, or 50 pieces of uncooked spaghetti laid end to end, or 1/215 of the Golden Gate Bridge, in one second. These statistics mean nothing, of course. What's important is that, unless you're going to move your mouse at more than 28.4mph (that's 0.7mph faster than Usain Bolt's 2009 world record-setting speed), it will keep up with you. It'll predict your movements, too, if the sensor ever loses track of the surface.

Having a right button that extends slightly further than the left means the mouse looks rather like the unholy offspring of Mater, from Disney's *Cars*, and Nosferatu. That's not a mouth we'd want to put our fingers in—there are surprisingly few we would, thinking about it—but the button placement on the G402 is unlikely to cause the loss of too many digits.

Unlike it's bigger brother the G502, there is no absurd sensitivity setting here, topping out at a mere 4,000dpi—high enough for most uses. The body could benefit from being a bit bigger for the palmers out there, and makes use of an awful lot of plastic in its construction, but if you've got the fastest hands in town, this is the mouse for you.

SPECIFICATIONS

Sensor	Optical
Max sensitivity	4,000dpi
Programmable buttons	Eight

VERDICT 8

Logitech G402 Hyperion Fury

SPEEDY No other mouse can keep up.

SEEDY It's still not as good as the G502.

$46, www.logitech.com

ASUS STRIX CLAW

Beware, small furry mammals

SADLY NOT A RANGE of peripherals inspired by everyone's favorite magic potion-powered basher of the Romans, Strix seems to be a sister brand to Asus's Republic of Gamers line, which has produced some excellent gaming mice in the recent past.

So, Strix. That's a genus of owl, in case you were wondering, and owls are fond of eating mice. In naming a mouse after owls, crafty ol' Asus is indulging in a bit of linguistic reappropriation to take the power back from the owls. About time, too. Power, as the philosopher Michel Foucault wrote, is not possessed but exercised, "[power] exerts pressure on them, just as they themselves, in their struggle against it, resist the grip it has on them".

The Claw can't be said to resist the grip you have on it exactly, but it doesn't feel great in the hand. The shiny finish would be quite tactile if it didn't feel so thin, but we managed to use it without puncturing the casing. The Omron switches under the main buttons feel like they're good quality, but the same can't really be said for the programmable side switches, which make a disappointingly weak click when they're depressed. It's also perfectly possible to accidentally press the lower of the three with your thumb if you move the mouse to the right in a hurry. Which isn't ideal.

The Claw's cable emerges from something not unlike a Roman galley's ramming prow at the front of the body. The box the mouse emerges from makes a big thing of the cable helping to counteract snags and tangles, and as this prow has a sharp tip, we can only assume it's there to cut the cable of another mouse it's become tangled with, LAN parties being the close contact sports that they are.

The Claw isn't a bad mouse, all in all, but it feels cheap, and there are better options out there for the money.

SPECIFICATIONS

Sensor	Optical
Max sensitivity	5,000dpi
Programmable buttons	Eight

VERDICT 5

Asus Strix Claw

TAWNY Good ergonomic shape; effective main buttons.

SCRAWNY Feels cheap but isn't.

$60, www.asus.com

STEELSERIES RIVAL

A subtle, even elegant, gaming mouse

"THAT'S A NICE MOUSE," says the snake-hipped art editor from our sister title *Mac|Life*, who slinks in and sits at one of our computers while wearing a hat fashioned from a single piece of aluminum in California. He's handling the SteelSeries Rival, and he's right.

It doesn't look much, on the outside. It's certainly the antithesis of anything produced by the Cupertino phone manufacturer, being large and black (though also available in pale-horseman white), and throbbing with orange light. But it's in its restraint and refinement that this mouse shines.

The Rival is a long mouse, one that palmers will probably be more at home with, and would be almost rectangular if it weren't for a sexy little shimmy to the right halfway down its length. This is what passes for ergonomics, and means a left-hander could use the mouse with little difficulty as long as they could deal with the buttons being on the wrong side.

Those side switches are subtle, being flush with the casing and almost invisible until needed. The rear switch is longer than the front one, allowing for a range of hand positions, and takes the same amount of pressure to activate no matter where you press it. None of the buttons have a great deal of travel, even the wheel button, but the switches they rest on are rated for 30 million clicks, so this looks like a mouse engineered to last.

If you've got a 3D printer handy, you can download a template from the SteelSeries website to make a custom name-plate for the back of the mouse (to replace the default one that says "Rival"). This way, at the end of the school day when everyone collects their mice from the hooks out in the corridor, you'll always know which is yours.

SPECIFICATIONS

Sensor	Optical
Max sensitivity	6,500dpi
Programmable buttons	Six

VERDICT 6

SteelSeries Rival

STEEL Gorgeous, restrained design; built to last.

SQUEAL Not particularly exciting.

$54, www.steelseries.com

ZALMAN M400

Switching passivity for activity

ZALMAN, THE QUIET PC SPECIALIST famous for its too-nice-to-go-in-the-case Flower range of passive CPU coolers, has made a mouse that will lead to a very noisy PC user. It's one for the claw-grippers, but feels so cheap the grip is unlikely to last for long.

On the plus side, it's the only mouse in the supertest that we received with a little plastic cover over the end of the USB plug, which is a nice touch. But it just highlights how that kind of attention to detail is lacking elsewhere. If even a bit of that love had been deployed on the rest of the mouse, the M400 would've been greatly improved.

There's its shape, for a start. We don't know if you ever used the, shudder, "puck" mouse that came with Apple's iMac G3, but it was round and foul and utterly gross, as if belched from the very bowels of Satan himself. The only way to possibly know which way it was facing was to use the cable as a guide, and it rotated under your hand.

The M400 isn't as bad as that mechanical monstrosity, but the roundness of its underside did bring on queasy 'Nam-like flashbacks. The top is shiny, running a constant risk of finger-slide, while the side buttons are too far back, especially if you try to palm the body. On some mice you can still press the rear button with the inside of a thumb joint, but not here.

What appears to be a grippy panel on the left for your thumb is also shiny and slippery, and the only part of the mouse that lights up is directly beneath the widest part of your palm, where it's completely hidden. The wheel is too low and its clicks too soft as it turns. Unusually for a device marketed as a gaming mouse, it doesn't come with software to program its buttons, but then it's also very cheap.

In the battle of the budget mice then, it's not much of a contest. We'd take the Fireglider every single time.

SPECIFICATIONS

Sensor	Optical
Max sensitivity	1,600dpi
Programmable buttons	Zero

VERDICT 4

Zalman M400

FLOWER Not bad for the money; USB cover.

DOUR But we'd still take something else.

$15, www.zalman.com

AORUS THUNDER M7

Maximizing its potential is a game in itself

THE THUNDER M7 absolutely reeks of quality as you open its box within a box to find a fabric case of promise lurking inside. Unzip this, and the matte-black mouse is displayed on a black lining, the sort of peripheral that makes passers-by peer over and say, "sweet!"

It's a blunt mouse for sure, a black sledgehammer that's long and broad and high—claw-grippers will be fine, as long as they can lift their hairy thumbs to press the eight buttons found on the left-hand side. But this is really the domain of the more delicate palmer. Those eight buttons mark this out as an MMO mouse, a rival for the R.A.T 7 MMO rather than the Logitechs or the Asuseseses.

If forced to choose, we'd take this over the R.A.T. It's so much more comfortable to hold, and feels like it could adapt to any kind of game and style of play without overwhelming you with options like Mad Catz's insane invention. It has a hump on the right like the Element Iridium, but does it right by putting it further back and allowing the ring finger to linger on it for long periods. It's made out of clear plastic and, along with the ridge created by the line of buttons on the left, means your grip is always secure.

Stop us if we're gushing, but if it weren't for the limited appeal of MMO mice, the Thunder M7 would be a contender for a position up at the very front of this supertest. We hate to criticize (no, really, don't you believe us?) but one issue is that the wheel is merely OK. It does the job but there are simply many better ones out there, such as the CoolerMaster Reaper and the Corsair M65 in this test. Its tyre is too narrow and it sits too low.

This wasn't the best mouse we tried, but it's the best MMO mouse we tested, and that has to count for something, for someone...

SPECIFICATIONS

Sensor	Laser
Max sensitivity	8,200dpi
Programmable buttons	16

VERDICT **8**

Aorus Thunder M7

THUNDER Good quality, good looks; really comfortable.

BLUNDER Complicated and expensive.

$80, www.aorus.com

ROCCAT TYON

That's Tyon, not Tyrion, *Thrones*' fans

ANOTHER MMO MOUSE, the Tyon is lighter and cheaper-feeling than both the R.A.T and the Thunder—despite sharing the bulky presence of the latter—but it does have some interesting design ideas that can't be found on any of the other contenders in this supertest.

The first thing that stands out is that the buttons are not clustered around the thumb as they are on the other two MMOs—instead, it has extra switches at the sides of the main left and right buttons. These stand tall over the flat main buttons, but have sloped tops so they can be pressed with a slide of the fingertip rather than having to lift your whole finger up. After all, who's got time for that?

This is bad news for claw-grippers, as it doesn't fit into their handling structure at all well. Palmers, however, will have no problems, and the fin button on the center-line of the mouse's back, designed to be pressed to either side by the knuckles of the index and middle fingers, makes it even clearer that this was designed with their kind of grip in mind.

The Tyon's oddest, most intriguing feature has to be the analog switch that's operated with the thumb. It's a tiny joystick that only moves in two directions, and springs back to the center when released. Potential uses include controlling the speed and direction of turret rotation, and it's got enough resistance to thumb pressure that it can be held precisely where it's needed. Also under the thumb, and a little too easy to accidentally press, is a shift button to switch to a second bank of custom functions.

Those who like the Tyon's idiosyncratic layout will no doubt love it, and there are certainly some sensational ideas to play around with. But it'll take a lot of time to get used to and, when something like the Thunder already exists, many won't bother.

SPECIFICATIONS

Sensor	Laser
Max sensitivity	8,200dpi
Programmable buttons	16

VERDICT **7**

Roccat Tyon

IDEA Plenty of thought has gone into this mouse.

UREA Too many people won't dedicate the time needed to master it.

$85, www.roccat.org

EVGA TORQ X10 CARBON

Space-age materials don't beat old problems

"REAL CARBON FIBER SURFACE!" shouts the website. This is going to be the aluminum Reaper again, isn't it? Maybe not.

If it's the sides or the top of the mouse that are made from carbon fiber, we couldn't tell, but any weight-saving gains from using F1 teams' favorite material are lost thanks to the solid metal frame and base lurking underneath. And that's before you start fiddling with the weights, a supply of which is included in the packaging, along with a cute little Torx screwdriver for adjusting the height of the mouse body.

It ships in the lowest position, and seems balanced between palming and claw-gripping, but jacking the mouse up to its greatest height makes a drastic difference if you're a palmer.

It's an odd-feeling mouse. The sides look as if they're going to be as smooth as ice, but once you get your fingers on them they're surprisingly grippy. The top surface is pitted and almost warm to the touch... presumably it's some sort of preserved animal flesh. Or it might be the carbon fiber. We'll probably never know.

It's the only ambidextrous mouse in this supertest, and as such has buttons on both sides of the body. The side switches are a touch on the wobbly side, which is disappointing, and have several millimeters of travel after the switch has clicked. The main switches are Omrons, good for five million clicks, and the wheel that's slung between them is a touch stiff to turn and doesn't click in very positively. Its click is quiet too. Without immediate on-screen feedback there could be a question over whether your press has registered.

Unless you're left-handed, it's hard to recommend this over others we've tested. The carbon fiber is nice, but it feels like you're paying for a pricey material at the expense of other more important features.

SPECIFICATIONS

Sensor	Laser
Max sensitivity	8,200dpi
Programmable buttons	Nine

VERDICT 5

EVGA Torq X10 Carbon

CARBON Good mouse for either hand.

CARPET Why add the carbon fiber? Why?

$75, www.evga.com

CORSAIR VENGEANCE M65 RGB

A showoff that still prioritizes functionality

SO FAR IN THIS SUPERTEST, we haven't mentioned customizable lighting systems much. That's been no accident. It's because almost every mouse may have them nowadays, but they add absolutely nothing to the use or performance, unless you're prone to losing yours in the dark pit beneath your desk that occasionally spews goblins who steal your socks—a distinct possibility thanks to the long cables now being attached to mice as a matter of course.

The other reason is that nothing can live up to the M65 RGB in terms of the customizability or sheer bloody stupidity of its excessive lighting.

For something that spends its life hidden by your hand, out of even your peripheral vision when your eyes are glued to the screen, the only conclusion to draw is that the mouse's 16.8 million color palette—with roughly seven million more colors than the human eye can distinguish—is for other people to look at. You know, the people who watch you play games but move so quickly they vanish when you turn your head. You know they're there though. You feel them watching you. Just us? OK.

The mouse's aluminum body keeps it light and rigid, and the shape makes it a good fit for palmers. There's a smooth black coating on the top that's soft to the touch, which gives way to something much rougher at the sides for you to get hold of. The main buttons are responsive, but we found the side buttons a little less satisfying, pressing the wrong one on occasion as they seem to blend into one another.

The best thing about the M65, however, is the wheel. It's broad with a lovely grippy tyre on it, its graduations distinct from one another without making it hard to turn. That wheel caps off an excellent mouse, although we'd like to see a version with no lighting system that's about half the price.

SPECIFICATIONS

Sensor	Laser
Max sensitivity	8,200dpi
Programmable buttons	Eight

VERDICT 8

Corsair Vengeance M65 RGB

COLOR Great wheel; excellent chassis; feels good.

SQUALOR The colored lightshow is pointlessly adding to the price.

$86, www.corsair.com

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AND THE WINNER IS...

LOGITECH G502 PROTEUS CORE

A SUPERTEST OF GAMING MICE was always going to be a mixed bag. Anyone can take a mouse and slap a gaming label on it—a few here have done just that. "Professional gaming" in one case.

Having multiple, programmable buttons is a given, but the term has also come to mean anything with a ridiculous lighting system and a long cord. It's the versatility that's actually important, however, as the button setup for *World of WarCraft* is going to be radically different to that for *Evolve* or *Total War*. This is the main area where the Zalman M400 falls down, though you can still assign commands to its buttons on an individual game basis if you want, if the title allows you.

MMO mice are studded with so many additional buttons that they've become like extra keyboards, reliant on their software to map commands to where you want them. We haven't worried too much about reviewing the software in this test, as each program is dedicated to its own mouse and each program works. We didn't get a single case of a program failing to recognize that the mouse was attached, or any failures during the inevitable firmware updates. If you've been PC gaming for any length of time, you'll know this is unusual. Your mileage, as ever, may vary.

MMO mice are complex, and not always suited to a wide variety of games. If this were a test of MMO mice, the Thunder would probably win, but just in case you don't keep a special mouse for each style of gaming, we've tried to focus on those that will best adapt to the broadest range of game experiences.

That brings us to the general gaming mice. Those with only a few programmable buttons and with more conventional shapes (as long as you're right-handed, there's only one ambidextrous mouse in this test). That's why the two mice at the beginning of this supertest were chosen. They are, if you like, the winners, though we realize they won't appeal to everyone.

OF MICE AND MEN

Logitech has been doing this for a long time, and the company's G502 is currently its range-topper. So this mouse really should be good. And it lives up to expectations. It's an unfriendly-looking, angular beast. A bit cold even. But the quality of its engineering and the thought that's gone into its design mean that there's little better out there at the moment.

The Sharkoon Fireglider came as more of a surprise. We knew nothing about it and just wanted one of the cheapest gaming mice we could find—not because everybody loves an underdog, but because everybody loves a rant. It surprised us with its versatility—even though it has a weighting system it doesn't really need—and was a comfortable mouse we could use all day. We deliberated about putting it in the top two (is that something true hardware freaks would do? It's $23, practically a disposable product!), but in the end its user-friendliness was so impressive it won through.

So there we go, a budget winner and a more expensive winner. The main lesson from this is that getting the basics right with a gaming mouse will lead to a superior product, rather than slapping box-ticking, easily marketable extra features on a chassis that isn't comfortable to use for long periods or that has an absurd gimmick it relies on to attract the mouse-buying public. So, when someone releases a gold-plated, perfectly spherical mouse with a self-righting weight in its base and multiple laser sensors to read the walls of the room it's used in, remember this.

"The lesson is that getting the basics right with a gaming mouse will lead to a superior product.

Broadwell: It's Business Time

A helluva long time coming, Intel's new 14nm CPU family is finally here

BY JEREMY LAIRD

All systems are go with 14nm technology. If there's a single message that Intel wants to hammer into your head with its new family of Broadwell CPUs, it's this: 14nm is on line. Moore's Law lives on.

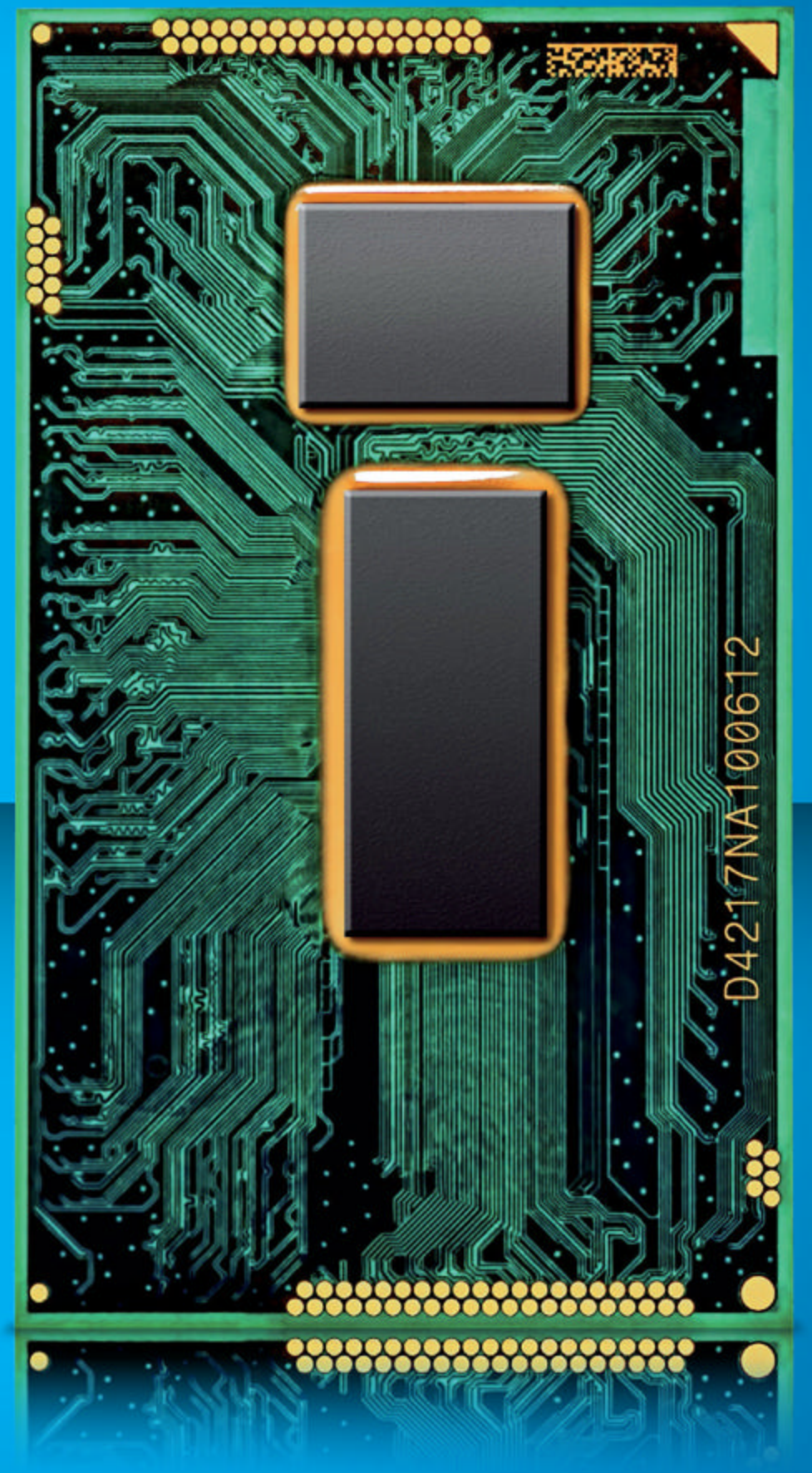
The reality isn't quite so simple. The reality is that Intel has fallen behind its self-imposed schedule of bringing out a new CPU architecture and then a new production process or die shrink in successive years.

As we'll see, as chip features get ever smaller, the production process is becoming one hell of a challenge. As Intel's CPU designs become ever more refined, the new architecture bit ain't all that easy, either. Not if you're expecting substantial gains in performance. That's the context for the new Broadwell family. It's running late. And it's a lot to ask for it to be dramatically better than Intel's already-excellent CPUs. And yet there are reasons to be very glad it's finally arrived.

For starters, thanks to that tricky 14nm tech, Broadwell is by far the most energy efficient architecture Intel has ever created. No, that doesn't automatically translate into epic increases in performance. But it does mean you can have proper PC performance in form factors where it wasn't previously possible. Broadwell also represents yet another big leap in integrated graphics performance. And that begs the age-old question of whether great gaming performance on integrated graphics is finally possible.

On the other hand, Broadwell also reboots our ongoing concerns with Intel's strategy regards the pure-CPU portion of its chips. For some time now, it's felt like Intel has been sandbagging on the CPU side, something that's been made possible thanks to the failure of its main rival, AMD, to offer serious competition.

Broadwell's lateness is also creating confusion in the context of the anticipated arrival of its successor, known as Skylake. As we go to press, Intel hasn't actually announced full details of the desktop Broadwell range. But we're expecting Skylake, including desktop derivatives, to arrive in the second half of this year. It's all a bit baffling. So let's start to make sense of Intel's 14nm mess.



The wait is over. Broadwell is here at last.

Something has gone wrong at Intel. It was back in June 2013 that we first got our hands on desktop variants of Intel's Haswell family of CPUs. Now here we are roughly two years later and Intel has yet to announce desktop Broadwell processors.

Meanwhile the successor to Broadwell, an all-new architecture known as Skylake, is due later this year. For a company famed for its well-oiled and accurate execution of new product launches, of late at least, it's all a bit untidy.

It also makes a mockery of protestations from Intel that it's "on track for a healthy 14nm ramp." Undoubtedly and undeniably, 14nm has been problematical for Intel. But then the entire chip industry is increasingly struggling to keep Moore's Law on line. Not that we should be surprised by that—current chip technology is fast approaching a tiny thing that's going to be a big problem. The size of the atom. (See "No More Moore" on page 44.)

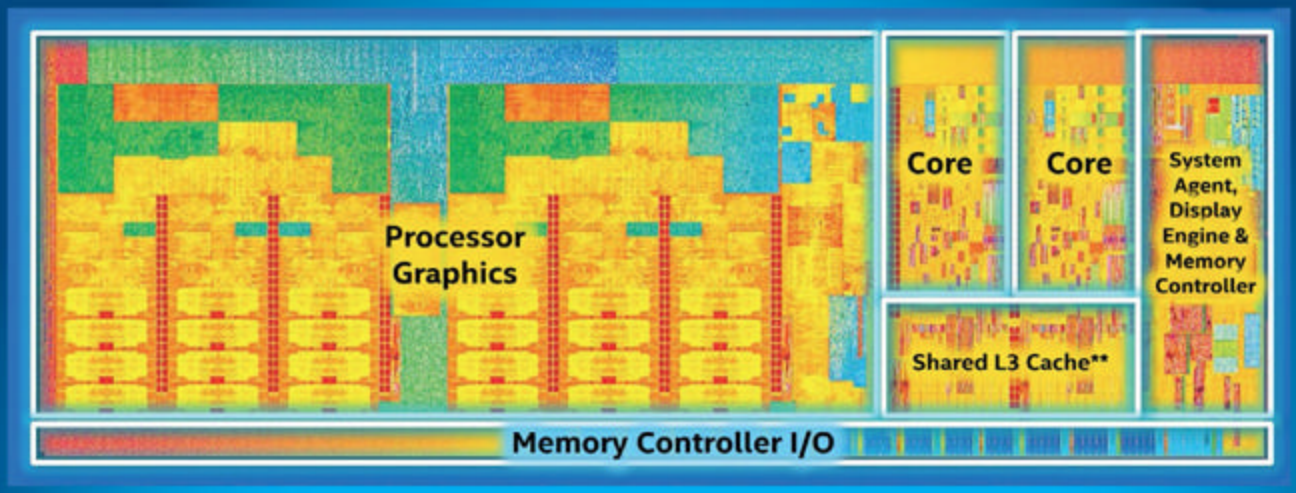
Anyway, Broadwell ought to have been available in full back in 2014. As it is, Intel only managed a trickle of dual-core mobile models late last year. At the same time, Intel says it's sticking to its plan of rolling out Skylake later this year. All of which begs two questions. What does Broadwell have to offer and is there any point to it for PC enthusiasts? Cue the Intel marketing machine.

PRODUCTIVITY PLUS?

If you want the classic elevator pitch for Broadwell, it goes something like this: Broadwell is Intel's fifth-generation Core processor. It's the first Intel chip to be built on 14nm process technology and offers the smallest chip features ever. It's much more efficient, with better battery life, and you get much faster graphics. Conspicuously absent from the pitch are big claims regarding the CPU subsystem of the new chips. Hold that thought though, we'll come back to it shortly.

Broadwell's first foray onto the desktop, still in mobile clothing.

First, let's knock about a few numbers that get to the heart of what Broadwell is about. Unfortunately,



THE CORE OF THE PROBLEM

The future's bright. The future's massively multicore...

So went the Intel PR pitch at multiple installments of its IDF techfest. Today two cores, tomorrow four, in years to come more than you could count.

Recently? Not so much. That's reflected in the fact Intel's mainstream processors still only have four cores, nearly nine years after its first quad-core CPUs were announced. So, what the hell happened?

There are two ways to look at this. Firstly, Intel is making CPUs with loads of cores, it's just not putting them into PCs. Want a CPU with 18 cores? Intel makes one for servers, albeit costing thousands. At best you can have an eight-core CPU in the high-end LGA2011 platform which is really just rebadged server technology, anyway.

You could also argue those cores have migrated to graphics. All of Intel's mainstream CPUs now have integrated graphics and if you take a peak at, say, the die shot of a dual-core chip with the big graphics core, it's at least two-thirds graphics. A quad-core model would be roughly 50/50. And, of course, that big graphics block has 48 execution units, which you could style as cores—suddenly you've got a 52-core chip.

Indeed, that graphics part of the chip can be used for some workloads that are traditionally CPU fare, such as video encoding. The problem with that view is that if you care about gaming, it's pretty much irrelevant. You'll have a proper discreet GPU and the gunk Intel integrates onto its CPU simply doesn't factor. That includes Broadwell's beefed-up graphics, as good as it is by integrated standards.

No, however you slice it, Intel's mainstream CPUs are still four cores. Nearly a decade on, that's disappointing.

Intel has yet to release proper numbers or even model names for any desktop Broadwells, or even quad-core mobile Broadwells. So the best data available relates to dual-core mobile chips. We'll compare the new Core i7-5600U with its direct predecessor, the i7-4600U. It's a high-end dual-core model with the biggest available graphics subsystem. It packs 35 percent more transistors than before at 1.9 billion, and yet the new 14nm process means it's also 37 percent smaller in terms of die size.

Its graphics is claimed to be 22 percent faster than the 4600U, hardware accelerated video encoding is a remarkable 50 percent faster, and battery life goes up by around 1.5 hours. Impressive. Less wonderful are the numbers relating to what you might call pure CPU performance. Intel is only claiming a 4 percent improvement in productivity performance.

There are several reasons for that. Firstly, Intel's x86 CPU cores are now very finely honed indeed. The low-hanging fruit in terms of performance optimizations were ripped from the tree long ago. If there's anything left dangling, it's just some very small stragglers on the hardest-to-reach branches.

What's more, Intel has reduced the maximum Turbo frequency of the 5600U by 100MHz to 3.2GHz. So that modest 4 percent gain is actually achieved at a lower peak operating speed. However, while the top Turbo speed is down a little, the base frequency is up by a hefty 500MHz to 2.6GHz. That should help in terms of sustained performance in thin and light laptops where heat can build up and prevent you from accessing the Turbo function. In that scenario, we reckon the 5600U might well be 20 percent quicker for CPU tasks than the old 4600U.

Of course, we also need to remember that Broadwell is a Tick in Intel's Tick-Tock chip development parlance. That means it's all about the die shrink from 22nm to 14nm; it's not meant to bring a dramatically new architecture. That said, Broadwell is being styled as a Tick-plus, and so more than a simple die shrink. But the "plus" bit is more about graphics and other features. In most regards, the CPU cores are carried over.

Anyway, that extra 1.5 hours of battery life is a big deal. It reflects an overall efficiency boost that will allow proper PC performance to be squeezed into yet smaller form factors. At this point in the Broadwell product cycle, it's early days. Keep your scanners peeled for ridiculously thin and light notebooks as well as just possibly some interesting tablets. We'd certainly love to see a Microsoft Surface with the most powerful Broadwell graphics options.

GRAPHICS GRUNT

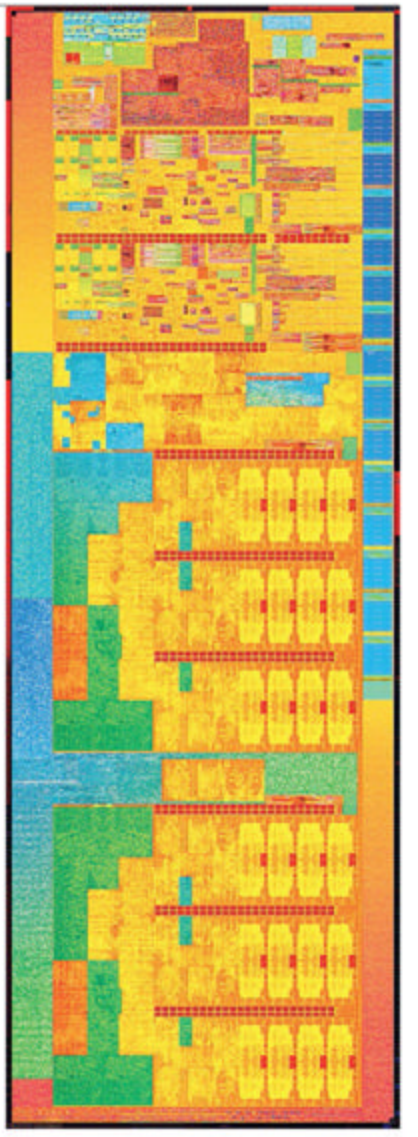
While we're on the subject, what of the new graphics technology in Broadwell? Power efficiency aside, it's got to be the most interesting aspect of the new architecture. In fact, it's the latest in a long line of improved integrated graphics from Intel in recent years. Intel claims Broadwell represents a 100-fold increase in integrated graphics performance since 2006.

That sounds like an incredible leap. However, the starting point in 2006 was so low that the 100x metric doesn't actually mean much. No, what really matters isn't how much faster Broadwell graphics is compared to something ancient and absolutely awful. What matters is whether you can game on it today.

On paper, the changes for Broadwell don't seem that dramatic. The basic graphics core gets a bump from 20 execution units to 24 and the fastest configuration goes from 40 to 48 units. Then you note that Broadwell graphics is a continuation of Intel's so-called Gen7 graphics architecture from Haswell and previous families of chips. And you might conclude we're looking at worthwhile improvements, no doubt, but hardly the stuff of 100-fold leaps in gaming performance.

But that wouldn't be entirely fair. Intel has given Gen7 a pretty hefty overhaul for Broadwell. It goes well beyond simply throwing a few more execution units at the problem of faster frame rates. For starters, Broadwell has been updated to support the latest graphics APIs. That specifically means Direct3D 11_2 now and support for Direct3D 12 (often simply referred to via the multimedia super set API that is DirectX 12) when it arrives with the final retail build of Windows 10.

Intel has also confirmed that Broadwell graphics is OpenCL 2.0 compliant, including shared virtual memory. So it really is a thoroughly modern graphics design, plus has all the general-purpose computing bells and whistles, too.



The first flush of Broadwell is all dual-core.

Broadwell's graphics revamp is far greater than it seems at first.

Just how nigh is the end for Moore's Law?

NO MORE MOORE?

The days of shrinking chips enter final decade or so as size of the atom rushes into view

Moore's Law is the observation, first noted by Intel co-founder Gordon Moore way back in the 1960s, that transistor density in computer chips tend to double every couple of years.

Put another way, it means the complexity and power of a computer chip of a given size doubles every two years. That, of course, gives rise to an exponential explosion in computing power over an extended time frame. Two becomes four and then eight, 16, 32, 64, 128, and so on. That's why today's desktop computers sport terraflops of raw compute power and why smartphones are faster than yesteryear's PCs.

But for how much longer? A bit like constant prognostications that fossil fuels will run out any day now, you could say reports of the demise of Moore's Law have been greatly exaggerated over the years. And yet with both oil and Moore's Law, it can't go on forever. One day the oil *will* run out. And one day Moore's Law *will* hit the wall.

With oil, it's hard to say exactly when. Nobody really knows how much oil is left in the ground. For existing chip technology, it's a little easier. The width of the atoms used in current chip production are roughly 0.2nm. The smallest atoms are hydrogen and they rock in at about 0.1nm. Today, Intel is selling processors with 14nm features. Immediately, then, there are hard, physical limits to how small you can make the transistors or gates within chips.

That doesn't necessarily limit the progression of computing per se. But at the very least we'll need a new paradigm, be that quantum computing or something else. Indeed, there are clear signs that the computer chip industry is already struggling to keep Moore's Law on track as feature sizes bear down on that final limitation—the size of an atom.

IBM recently gave up making chips, for instance, and the cost of the facilities or foundaries for chip making are rising in an exponential fashion that almost matches the increasing power of the computers they enable. There's at least a decade of further progress available. But after that, it really can't go on too much longer.

But it's the structure of the rendering pipeline where things get more interesting for we gaming addicts. Intel's graphics cores are subdivided into "slices." For Haswell, each slice had 10 execution units. For Broadwell, this drops to eight.

If that sounds like a step backwards, the point is that each slice has shared resources in terms of cache memory and sampler units. With fewer execution units per slice, you get more cache and more sampling for each execution. Individual sampler performance has also risen, the upshot of which is a 50 percent bump in overall sampler performance. Intel has also tweaked the ROPs, or render outputs, and rasterizers to up fill rates.

LUCK OF THE IRIS

The payoff from all of this is that the new mid-sized graphics core with 24 execution units, known as GT2, has nearly closed the gap with the old big graphics core, known as GT3, in Haswell. You can read the full details on page 76, in our review of the new Gigabyte Brix S, with its Broadwell-U Core i5 5500-U chip. But in both *Bioshock* and *GRID 2*, Broadwell GT2 is remarkably close to Haswell GT3.

What it's not, however, is what we'd really call fully gameable. In both games, average frame rates at 1080p and full detail with 4x antialiasing enabled are well below 30 frames per second. Even if you double the frame rates for the 48-unit Broadwell GT3, which we haven't tested yet, and add a bit for the eDRAM memory that comes with the very fastest version, known as Iris Pro, we're still talking marginal frame rates at 1080p in what are not exactly the most demanding games.

Actually, while we're talking Iris Pro, it's worth noting that both Intel's strange branding and its awkward positioning of its GPU technology looks like remaining with Broadwell. On the branding side, Intel is keeping the HD Graphics and Iris split. What's confusing is that Broadwell CPUs with the fastest HD Graphics 6000 solutions will get the 48-unit core, just like Iris 6100 and Iris Pro 6200 graphics. To us it would be easier for everyone to understand what they're buying if the 48-unit graphics was exclusively branded Iris.

As for the positioning, the problem has been that Intel has tended to restrict its fastest graphics to its higher-end CPU configurations. And that doesn't make any sense, especially on the desktop, but even in laptops. That's because any system with an expensive, relatively high-end quad-core CPU is going to have a discrete or plug-in video card, making the specification of the integrated graphics irrelevant.

Instead, it would would make much more sense to have a cheap dual-core CPU paired with the quickest graphics configuration and end up with something capable of a bit of light gaming for not all that much money. At least, it would make much more sense for us poor gamers and computing junkies. The problem is that big graphics means big computer chip.

Intel does do a dual-core chip with the big 48-unit graphics core for laptops, but you only have to glance at

Gesture-recognizing laptops with Intel's RealSense.

©CHEMICAL HERITAGE FOUNDATION

the die shot on page 42 to understand the problem. The graphics portion is huge. It's at least two-thirds of the chip, maybe more. The consequence is a mere dual-core PC processor with nearly two billions transistors.

Even taking into account the savings that come with a die shrink to 14nm, that pushes up the production cost and makes it tricky to sell a low-end model with the highest performing graphics. Eventually, graphics and CPU functionality will probably cease to be in any way distinct and the problem will disappear. For now, it means we can't quite have the precise configurations we'd prefer.

REALSENSE AND SENSIBILITY

If efficiency and graphics are the big deals, is there anything else to get excited about? Intel is talking up "enhanced capabilities" for Broadwell and they fall into a few categories. The first you might call more "natural" interactions.

According to the Intel spiel, with the PC we've gone from plain old text input to graphical user interfaces and then touchscreens and voice control. What's next? Adding senses to the PC, namely the ability to recognize gestures and facial expressions along with more natural language recognition. Now this isn't really a feature of a Broadwell CPU, but it does require processing power. And if you're going to have that processing power available in today's increasingly mobile form factors, you need the improved efficiency that Broadwell brings.

Intel's wireless display technology, WiDi v5.1, promises lower latency than ever.

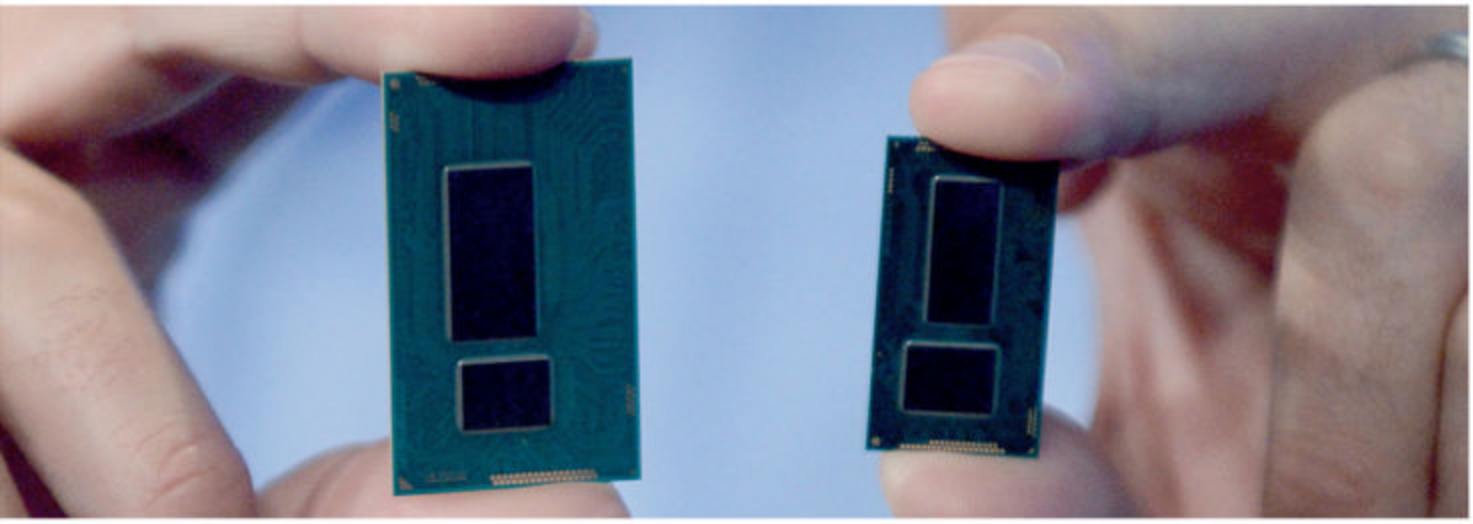
BROADWELL FACTFEST

In our quest to dive deep into the architectural nether regions of a new CPU family, it's sometimes easy to miss out on some fun little factoids, so here you go...

First, Broadwell is a proper 4K chip. No, not for gaming. Even Nvidia and AMD's finest dedicated GPUs struggle with that. No, we're talking 4K video displays and video decode. Broadwell has H.265 and VP9 4K decode capability and can output at 4K 60Hz assuming motherboard support. Which is nice.

While we're talking displays, Broadwell coincides with an update to Intel's wireless display technology known as WiDi. Version 5.1 is said to tout full gaming support, for which read lower latency than ever. To be frank, we'll want to try that for ourselves. Intel has also added a WiDi remote for easy dual-screen management. But here's the really interesting bit. WiDi now supports 4K. Again, this is something we really want to see first hand before getting too excited. It's the sort of thing that could be incredible. Or it could be a feature that looks great on paper, but requires such perfect signal integrity that it barely ever actually works. Still, you can get a WiDi v5.1 adaptor for your TV for under $50, so it's certainly not expensive technology.

And finally... did you know that Broadwell chips will be going into Chromebooks as well as Windows laptops? As Windows comes under more pressure from Apple's iOS, and Google's Chrome and Android operating systems, Intel is increasingly in favor of finding ways for its chips to work with a broader range of software. With Chrome apps and features increasingly offering an offline mode, having proper CPU power in a Chromebook could prove ever more worthwhile.



Haswell versus Broadwell—the difference a die-shrink makes.

DARE WE ASK ABOUT AMD?

Intel's only rival in the PC processor market continues to strive, and struggle, to keep up with the advances

Every time you think AMD is about to drop dead, some good news pops up. But you can be just as sure that any time things are looking up, some disaster or other lies just around the corner.

So where does that put AMD today? The context is Intel's ceaseless march. While we nitpick over its delayed 14nm technology, there's no denying Intel has broadly stuck to its Tick-Tock strategy of releasing new CPU architectures and new production processes in alternating years.

AMD, meanwhile, doesn't seem able to react. Its current performance CPUs are based on the Bulldozer architecture that appeared in 2011 and was supposed to take the fight to Intel's Core. It's been slightly revised on a few occasions, but there's no getting round it—Bulldozer is a failure. In fact, we'd say it's so bad that AMD would've been better off sticking with the Hammer CPU core that dates back to 2003 and was launched under the Athlon 64 branding.

AMD currently has little to excite PC enthusiasts or gamers. It's been pegged back to chips that just about make sense on account of being cheap. That means tight margins and narrow profits. Not good.

Enter Zen, its new x86 CPU architecture. It's due out in 2016—though on AMD's past form it'll probably miss that target—and few details are known. But rumor points to a launch on 14nm production technology, compatibility with AMD's FM3 socket, and support for both DDR4 memory and PCI Express 3.0 interconnects.

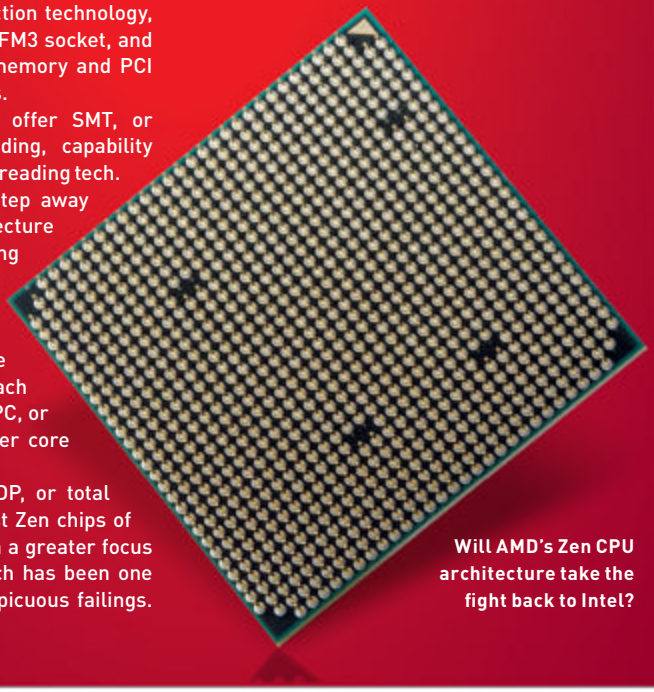
It's thought Zen will offer SMT, or simultaneous multithreading, capability similar to Intel's Hyper-Threading tech. It will also likely be a step away from the modular architecture of Bulldozer, with its pairing of what you might call two small cores into a module with shared resources, back to a more traditional big core approach with more emphasis on IPC, or instructions processed per core and per clock cycle.

Another detail is a TDP, or total design power, for the first Zen chips of up to 95W, combined with a greater focus on power efficiency, which has been one of Bulldozer's most conspicuous failings. Taken together, the combination of 95W TDP and increased efficiency confirms that AMD intends to compete at the performance end of the market.

If all this sounds similar to Intel's strategy since its switch from the high-clocking Netburst Pentium 4 architecture to the IPC-tastic Core processors, even the code-name for the first Zen processors, Summit Ridge, sounds distinctly Intel-ish. Arguably, however, Zen will succeed or fail more on execution than broad strategy.

Bulldozer's modular architecture could have been a winner. But it was poorly executed from day one. For a company with limited resources like AMD, rectifying that initial mis-step has proven pretty much impossible. The final question is whether Zen is AMD's final roll of the dice. If Zen fails, does all of AMD go down? Possibly. It will depend on AMD's plans to also launch its own chips based on the ARM instruction set, a new architecture known as K12.

A Zen failure will almost certainly kill off AMD as a vendor of x86 processors. If that happens, AMD will be left trying to make a mark on the viciously competitive market for ARM processors. And for the record, AMD probably can't survive solely on the strengths of its graphics chips. If the CPU business collapses, AMD is unlikely to survive as an independent entity.



Will AMD's Zen CPU architecture take the fight back to Intel?

Intel is actually getting into this game itself with its own technology, known as Intel RealSense, a feature set based around 3D-capable sensors. There's a conventional color camera in the center, flanked by an IR laser projector and an IR camera. Together, these allow objects to be scanned for depth and dimensions. Finally, there's a stereo microphone array.

Put these sensors together and you have a system that supports gesture control using hands and fingers, facial expression detection, head tracking, and object scanning, the latter enabling model creation for 3D printing. It also includes a Voice Assistant with basic offline and more sophisticated online components similar to Apple's Siri and Microsoft's Cortana voice control systems.

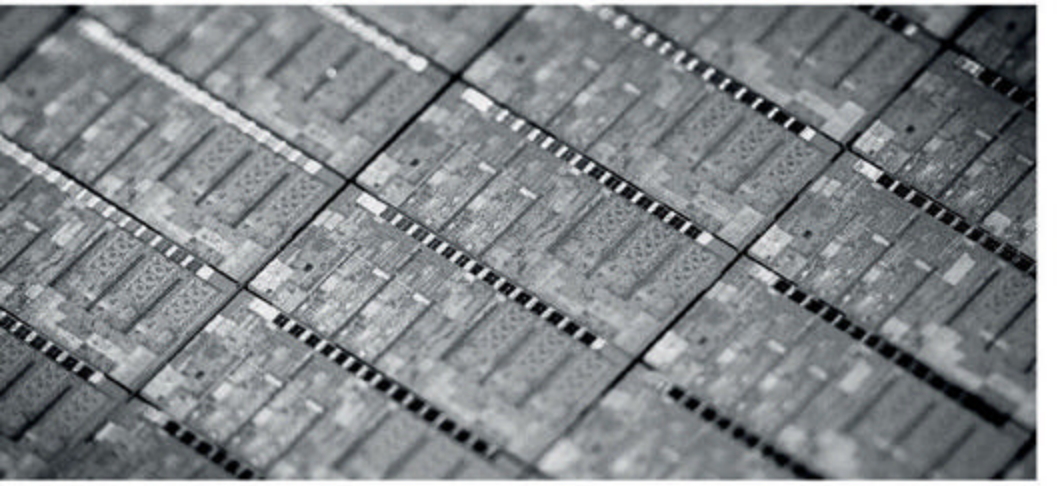
If that sounds like the kind of high-concept technology Intel often touts but in reality fails to bring to market, well, RealSense is actually shipping today in Dell's Venue 8 tablet along with notebook PCs from Asus and Lenovo. That said, we've yet to see it in action, so we can't judge whether it'll catch on. What we can say is that Intel is up against some seriously stiff competition from Apple, Google, and Microsoft in this area.

SKYLAKE LOOMING

So, that's Broadwell itself covered off. The obvious question is what's next? Actually, that's a more critical question than usual since Intel's 14nm derailment means that by the time desktop Broadwells arrive along with quad-core mobile models, the follow-up family of chips, known as Skylake, will be imminent too.

Full details of Skylake haven't been released, but if we combine what Intel has revealed with the best of the leaks and rumors, we can get a pretty good idea of what to expect. Firstly, Skylake is an Intel "Tock" and that means a new architecture on the prevailing production process, which is now transitioning to 14nm.

As ever, graphics is a major part of the Skylake package, both literally and in terms of importance. Rumor has it Skylake will introduce a new "GT4" spec graphics configuration with no fewer than 72 execution units. That means nine of those eight-strong execution-unit slices instead or six, or a straight 50 percent boost in computational complexity.



To die for? Questions remain as to how Broadwell will exist alongside Skylake.

Normally, we wouldn't be hugely excited at the prospect of some far-off integrated graphics core. But Skylake is just around the corner and if it really does have 72 units, it's going to be massively quicker than today's best Haswell graphics.

That said, arguably more interesting are the platform developments that come with Skylake. First up, there's a new socket, LGA1151, which breaks backwards compatibility. Where desktop Broadwells will drop into existing Intel 9 Series motherboards, Skylake chips will need a new mobo.

If that's the bad news, the good news is that the new socket means a properly new desktop platform along with new 100 Series chipsets topped out with the upcoming Z170. Reportedly, both Skylake and the new chipsets will support both existing DDR3 memory and the new fangled DDR4 stuff that's so far been restricted to Intel's high-end LGA2011v3 socket and CPUs. However, actual motherboard implementation will see only one memory type appearing. We won't see boards that can take both memory types.

DDR4 probably isn't a big deal for mainstream desktop gaming rigs. But the boosted bandwidth should help keep those mooted 72 execution units in the new graphics engine fed with frame data. The other headline grabber is a bump for PCI Express lane availability, up to 20 lanes from 16. That matters because storage subsystems—specifically SSDs—are moving to the PCI Express-based M.2 interface. For dual-card multi-GPU SLI or Crossfire graphics, you want at least eight lanes per graphics card. With an M.2 drive pinching a few of your 16 lanes, there's a problem. With 20 lanes, you've got four spare for a couple of fast SSDs. Perfect.

However, where things get really complicated is the relationship between Broadwell and Skylake on the desktop. Broadwell's lateness combined with Intel's plan to stick with its schedule for Skylake has created some distinct weirdness. According to leaked Intel roadmaps, this is what it's going to look like. Broadwell desktop CPUs will be the unlocked K-series models only. There won't be any mainstream locked Broadwells on the desktop. Instead, those slots, which represent the bulk of Intel's desktop offerings, will come from the Skylake family.

It's an odd situation and leaves a lot of questions unanswered. For instance, will there be unlocked Core i5 Broadwells with no Hyper-Threading, as there have been for several generations? And what will Intel call these chips? Will it launch what it calls fifth and sixth-gen Core processors? Or will it simply brand them all as fifth generation?

Can Skylake's GT4 graphics give us gaming in such small form factors?

Then there's the not-so-minor matter of multiple platforms and multiple sockets that lack cross compatibility. It's bad enough that Intel now splits its desktop offerings into separate mainstream and high-end offerings. It now seems that, for a while at least, you'll have to choose between two mainstream platforms: the existing LGA1150, which Broadwell CPUs require, and Skylake's new LGA1151 socket.

What's more, the way Intel has done this is probably the opposite of the ideal. If you've forked out for an expensive unlocked chip, you're likely to want the latest platform technology with those extra PCI Express lanes and DDR4 support. But those will only be available with locked Skylake chips.

DOUBLE TROUBLE

Whatever, it will be very odd to have what is an older architecture in Broadwell sitting above the newer Skylake models in Intel's hierarchy. At the very least, it possibly means that Skylake's CPU cores won't be anything to get excited about. After all, unlocked Broadwells selling as range toppers will need to be faster than their cheaper and locked Skylake siblings or the whole thing really will come tumbling down. All will become clearer in the coming months, but it's odds-on that Intel will have to pull some marketing tricks to make sense of this weird mishmash of new products.

As for what happens after Skylake, we really are into crystal ball territory. There are a few known facts. Skylake will be followed by a family of 10nm die shrink chips called Cannonlake. Due in 2016, they'll come with another new platform, the 200 Series chipset, and pair with DDR4 only.

All of which means we've mixed feelings about Broadwell. We're disappointed that it likely won't push on Intel's game for pure CPU core technology. But the power efficiency and graphics look like a big step forward and it's nice that it should drop straight into existing 9 Series motherboards, albeit with a BIOS update required.

How will it all work with Skylake arriving at nearly the same time? Well, that remains far from clear and could determine whether Broadwell makes a mark or turns out to be too little too late.

Life Beyo

Are there any realistic alternatives to Steam, for gamers or developers?

By Daniel Griliopoulos

Our beloved editor loves his thought experiments. "So, if Steam evaporated tomorrow," he mused, leaning back in his throne made of last-gen graphics cards, "where would gamers go for their games? Get on it."

Of course, there's no evidence that Steam is going anywhere, or even changing. But that's not an answer that will make our leader very happy. To be fair to him, however, we've no idea of Valve's long-term plans—the company is as open as a paranoid clam. It's a show of how little we know that before Microsoft revealed its big Windows 10 surprise to be HoloLens, it was mooted that it could've been a Steam buy-out. (Not such a stretch, given Valve's owner Gabe Newell spent 13 years at Microsoft.)

But it could end. And what then? Where would we get our PC games? Well... plenty of places (see "Letting Off Steam" on page 50). Steam isn't just about buying games, though, like it was back when it launched way back in 2003.

nd Steam

It fulfils most of the roles that gamers need. It handles digital distribution, digital rights management (whether you have the right to play that game or not), multiplayer and matchmaking, family-sharing, social networking, updates, cloud saves, groups, and now curation. For free!

It's hard now to remember quite how terrible it was to play PC games before Steam—when games such as *Vampire: The Masquerade—Bloodlines* could launch the same day as *Half-Life 2* but be broken beyond repair and there be no easy way to get a patch. Yes, you could go to FilePlanet and download one, if you were happy to wait for a couple of days, had paid for a subscription, and if the developer had made one (which *Vampire* developer Troika never did).

And Steam isn't just a place for gamers to buy games. It's also a place for gamemakers to sell games. It supplies a marketplace; the ability to track sales and player statistics; a way to set up discounts; free APIs to do your own code with; in-game achievements; network code and matchmaking; in-game micro-transactions; and support for modded content. All that for around 30 percent of your revenue. Compared to the usual 70 percent that retailers once took, that's an amazing deal.

Despite this wealth of functionality, however, all's not well in the land of Steam. It's possible the platform's Golden Age has already happened. Valve, from the outside, seems increasingly unproductive relative to its headcount and influence. It's effectively a monopoly owned by a single person. Anything could happen if he moves on.

And perhaps it's not healthy for games, as Leaf Corcoran, who set up the free indie game distribution site itch.io thinks.

The problem is that nothing else replicates the functionality of Steam. Three other platforms come close—Origin, U-Play, and Battle.net—but they're closed platforms, only selling games from AAA publishers. So is there any software that replicates each of Steam's functions? Read on to find out.

ILLUSTRATION: SIMON WINDSOR

First up, how do non-Steam games ever get updated? Well, the services that are publisher-specific—Origin, uPlay, and Battle.net—tend to update their apps themselves; GOG.com will notify you that downloads are available if you log onto its site or leave its downloader running; and some popular games have bespoke updaters built in—think *Minecraft* or *Terraria*. Most, however, rely on you checking in on their website every now and then to sort it out for yourself.

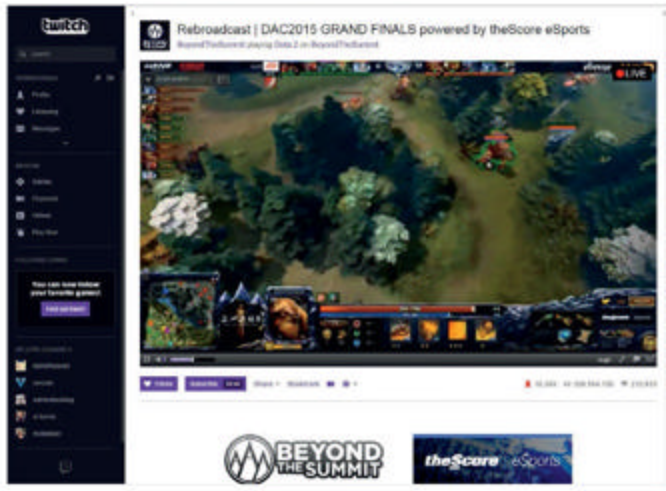
So, is there multiplayer available outside of Steam? Unless it's built into the game, no. Older multiplayer hosting services like GameSpy have died off, meaning Steam is pretty much your only way of finding multiplayer games, especially as many devs use Steamworks for their multiplayer tech.

GOING TO THE SOURCE

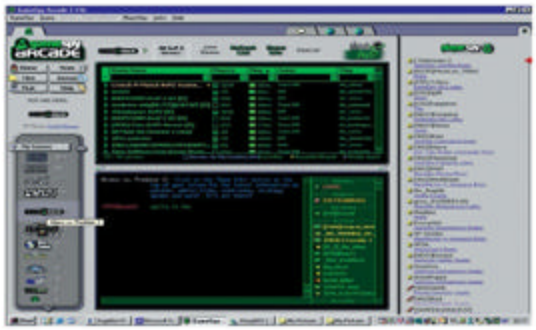
How about discoverability? Well, gamers can easily find new games through multiple sources, outside of Steam's rating and curation systems. Specialist media, such as the very magazine you're currently pawing with your grubby mitts, or independent sites like RockPaperShotgun, can recommend games. And it's easy to buy these games. Very few titles are Steam exclusives these days, with most games also being available through secondary digital distributors like GamersGate or GOG.

Indeed, itch.io makes Steam's lineup look boring and conservative, showcasing all the most weird and wonderful games from every corner of the world—and most of them free. Its creator, Leaf Corcoran, remembers there was no easy way to publish an indie game before it, with indies begging for votes on Greenlight. "It was depressing to see, and absolutely unnecessary for the sellers," says Corcoran. "Selling your game should never be about winning a popularity contest or having someone else tell you it's OK to sell. I think one of the reasons itch.io has been successful in making a lot of traction among all the other game marketplaces is that it hosts content that's actually different. The low barrier to entry for publishing encourages a lot of unique content to be uploaded. Itch.io is not just another site selling Steam keys."

That said, nowhere has the combination of AAA publisher, iOS conversions, F2P MMOs, and indie titles that Steam does—it's the only marketplace that shows such a large selection of the market. And services like GameSessions.com allow players to try Steam games before they buy. Steam also has another feature that might seem strange, but is actually crucial—social networking.



Game streaming is one area Steam comes second, due to Twitch.



The decline of GameSpy means Steam rules multiplayer.

GETTING PERSONAL

Social networking is the magic juice that makes achievements worthwhile, and is what the platform bases its game recommendations on. Players can rate games with the aggregate score appearing on the game's store page, replacing the critic review-derived MetaCritic score, and any individual or group can set themselves up as a Steam

LETTING OFF STEAM

The current alternatives to Steam

Origin

EA pulled its games from Steam, so Origin is the main place to pick them up (though U-Play also hosts them). It has social network features no-one uses, introduces annoying pop-ups, and occasionally gives away free old games and gametime for new EA games.

U-Play

Owned by Ubisoft, this app sells games from several AAA publishers, including Capcom, EA, and Square Enix. Lets you unlock trophies which provide points for buying DLC. Has social network features that no-one uses and annoying pop-ups in otherwise fun games.

Battle.net

The only place to buy and play the five-or-so Blizzard games, and it's owned by Activision-Blizzard. It has social network features that get heavily-used, given all the games have strong multiplayer. It gives nothing away—nickel and dimes you heavily for in-game content.

Curator. Why read a magazine review when your trusted friends all say you should get a game?

Similarly, though the Steam broadcasting tech is welcome, it's underutilized compared to that on the Playstation 4. Indeed, Twitch.tv is the big game streaming service, which produces and absorbs much more of the game streaming than Steam. Most users of that use products like the free Open Broadcast Software to create their videos, and Twitch itself to find an audience. Like *World of Warcraft*'s in-game voice tools, Steam had to offer video streaming but it's unlikely to ever displace Twitch.

The only app we're aware of that replicates any aspects of this social networking is the Raptr app, which also ships with ATI graphics cards. This social networking app runs in your dashboard and tracks all your gameplay, across many platforms, including PC, so you can see what your friends have been up to. It also replicates the community and groups that make playing games on Steam so handy, especially for finding the hardcore groups to play complex games like *Mount and Blade*, or guides to complex RPGs like *Divinity: Original Sin*.

> Nowhere has Steam's combination of AAA publisher, iOS conversions, F2P MMOs, and indie titles.

'Degrading' games is Bohemia Interactive's non-Steam piracy solution.

However, even Raptr can't handle another part of Steam's unique offering—family sharing. This is a little-known system that allows players to share games with other players. As long as you've logged-in on a computer and approved it for your account sharing, other players on that machine can play your games when you're not playing them. It's an extremely helpful part of the Steam experience that can only be replicated through non-DRMed games and, essentially, piracy. We use it for sharing games with our families, but are aware that most players don't even know it exists.

Two other unique elements of Steam are replicated by another major gaming site—Kickstarter. Yes, Steam's Greenlight system lets gamers vote on the titles they'd like

Humble

Mostly sells bundles which get games huge distribution but almost no money for the developers. Humble also sells mobile phone games. It also distributes games, with 10 percent of every sale going to charity and just 15 percent to Humble (half Steam's rate).

GOG.com

Originally "Good Old Games," it focused on selling no longer available classics, in forms that work on modern computers. However, as it's owned by CD Projekt (developers of *The Witcher*), it's taken to selling more new releases. It's the likeliest alternative to Steam.

Itch.io

Sells games solely from independent game developers (though its founder Corcoran told us he's open to hosting AAA games). Also organizes game jams, sells game bundles, and gives away free games. No money goes to itch.io. This is the place to buy your game!

The others

Gamersgate (not related to the insane mens' rights activism), Direct2Drive, Green Man Gaming, and many smaller sites make up a small part of the market. Some of them have original twists—such as GMG allowing users to resell digital games they've bought.

Future

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to see, and the Early Access system allows those voters to try (and to fund) games before they're ready—as long as they're in a vaguely playable state. But Kickstarter goes further. It allows players to approve games and gain access to the alphas when they're in a much worse state than Steam. However, Kickstarter offers no guarantee that the game you're paying for will ever be playable, whereas Steam Early Access at least means you'll have access to a broken version of the game.

ARRESTED DEVELOPMENT

So, while there's software that replicates most of the Steam experience for the gamer, it's not easy to get hold of and doesn't talk to the other software in the way that Steam does. The situation, however, is far worse for developers.

Digital distribution is the smallest part of the problem. It's exceptionally easy to distribute your game these days, given the wealth of data and store management software around. If you want to sell it directly, there's a ton of e-commerce software available, starting with something as simple as Paypal, if you're happy handling the software distribution and hosting yourself. If you want to automate it, software like X-Cart or Shopify can handle that for you, for a reasonably small fee.

Of course, getting someone to find your software is harder. How are people going to find out about your new game? "For indies the number one concern is visibility," says Tomasz Nalewaj, brand director of Good Old Games (GOG). "Even the best game ever isn't going to sell a single copy if nobody knows it's out there, and that's a very real concern. Greenlight and itch.io are part of the solution, but they're not perfect. If everyone is visible, then no one is. We go from a vacuum to white noise, and we're back to square one."

THE FREE MARKET

Most games are discovered through Steam, through adverts, or through the media and YouTubers. But it's a huge timesink to reach out to the last two, and it's expensive to employ a PR or community manager to do it for you. And advertising is expensive. So expensive that the cost to find a single buyer is often more than the money they'll spend. Steam is still

THE HAND OF GOG

Tomasz Nalewajk, brand director of Steam's nearest rival, Good Old Games, reveals his vision for PC gaming

How do you see the marketplace for PC games at the moment?
Stronger than ever. Gaming in general is exploding in the mainstream, it's no longer this kind of niche culture. People are actually proud to be gamers now!

Do you want GOG to grow into another Steam?
We want to grow and expand our userbase, but not at any cost. We want people to be confident that they can browse GOG.com, find something that looks cool, and end up with a solid game. Sure, we could give our catalog a major boost if we just said yes to everything, but we much prefer our way of doing things, we think it makes for a better experience. That means that we only release games that we, as gamers, actually want to play. We consider it a "boutique approach." The recipe for that is pretty simple: we actually play them. We'll try the game out, see if we like it, and go from there. GOG.com is growing all the time. We started out releasing good old games, and have since ventured into great indie titles and day-one premieres. We have no intention to stop improving either, so our next big step will be GOG Galaxy. We call it "the truly gamer-friendly DRM-free online gaming platform" and we want to make sure it's not just mere rhetoric. So yes, we plan to offer our community the standard stuff like achievements, stats, chat, etc., but the keyword here is "offer." You can use the online features if you want, but you can always rely on the old fashioned way—just you and your games.

Will Windows 10, with its focus on games, change the market?
Windows is, most definitely, a really huge part of gaming. In that sense, we're happy to hear Microsoft is placing some more importance on supporting our favorite hobby. It used to be that you absolutely needed Windows to really game, and while that's changing for Mac and Linux users (especially when it comes to the indie scene), those operating systems are still a far cry from offering as large a backlog and equal developer priority. But who knows, maybe Microsoft is reacting to those very changes, trying to stay competitive. That's definitely a good thing for the market. This sort of thing is always tough to predict though, and I'd rather not make any bold, sweeping statements.

Do you think new technology, such as Oculus Rift or HoloLens, will affect the market for games at all?
Absolutely. All it takes is a single look at people's reactions when they first try these new technologies to see we're definitely on to something. If the tech catches on, I think we'll even be in for a completely new genre of games designed specifically for VR headsets. At the same time, not every type of game out there is going to benefit: classic point and click adventures, 2D platformers, and most "retro" experiences come to mind. The tech is not for everyone either. VR headsets really take up all of your senses at once, and for some people that's just too much—they're not interested in that kind of immersion. In the end, only time will tell. Once upon a time 3D TVs were going to be the next big thing, and that didn't turn out to be quite as popular as predicted.

the best way to let people find out about your game, if you can get on it.

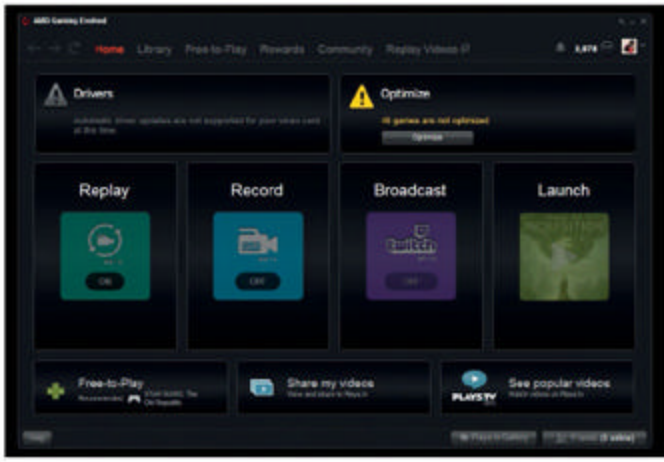
That said, it seems to us that even Steam's capability to market games is waning, mainly due to the weakening of its internal curation in favor of user curation. This new user curation system allows gamers to recommend games and gain followings on the basis of their recommendations. At the moment, it's mainly allowing big name websites and YouTubers to extend their brand, but it really amplifies the success of better-known games, such as *Shadow of Mordor*. A great game coming out of nowhere still needs extensive marketing or viral word of mouth to succeed, like *Spelunky* had.

ACCESS DENIED

Of course, once a buyer has your software, you don't want them to just give it to anyone else—unless you're GOG, which, as a point of pride, or as a marketing stunt, doesn't have any copy protection. Digital Rights Management (DRM) software is the usual method of restraining usage to a single purchaser, and it's included as standard in Steam, Origin, U-Play, and Battle.net.

There are off-the-shelf solutions for this—simple CD key software locks are available, and the infamous SecureRom and SafeDisc DRMs are well-known, but the problem is you risk preventing legitimate users who are temporarily without the Internet from playing their games. Steam handles this with an offline mode, which, while unreliable, allows you to play most games offline. Or you could do what Bohemia Interactive, creators of *ARMA* and *Operation Flashpoint* do, and allow players to play the DRM-free games, but gradually degrade their experience. If you're playing a cracked or DRM-free version of *ARMA*, your guns gradually lose their accuracy and on occasion you turn into a bird. That's sadly not something that's available off the shelf...

The downside of DRM is for the gamer—games released through Steam won't work if Steam goes down. Online libraries have closed before, like the original Sony Music Entertainment store. So, if Steam did collapse, we could lose access to our games. And we likely wouldn't have a legal foot to stand on, as many manufacturers are moving towards selling software as a license, rather than as a product, turning it from something we own into something we borrow. GOG's DRM-free system certainly seems better than that.



Raptr matches Steam's social networking, but lacks a family sharing system.

> "A great game coming out of nowhere still needs extensive marketing or viral word of mouth to succeed.

And how do you do multiplayer or matchmaking without Steam? There used to be an array of off-the-shelf solutions, like GameSpy, but with Steamworks supplying so much of the tech, they've mostly disappeared. Developers can create their own, but that's a hell of a lot of extra work. And, as the *Magicka* developers found out, if it doesn't work, you can end up with a lot of upset players. As Paradox North's Peter Cornelius admitted to us, getting the multiplayer working in *Magicka 2* was "a big feature."

Byron Atkinson-Jones, director of Xiotex Studios, recommends the Player.IO dev kit, though with caution, as Yahoo has just snapped it up. It's a set of free systems that

EURO-MESS

Taxing times for indie developers

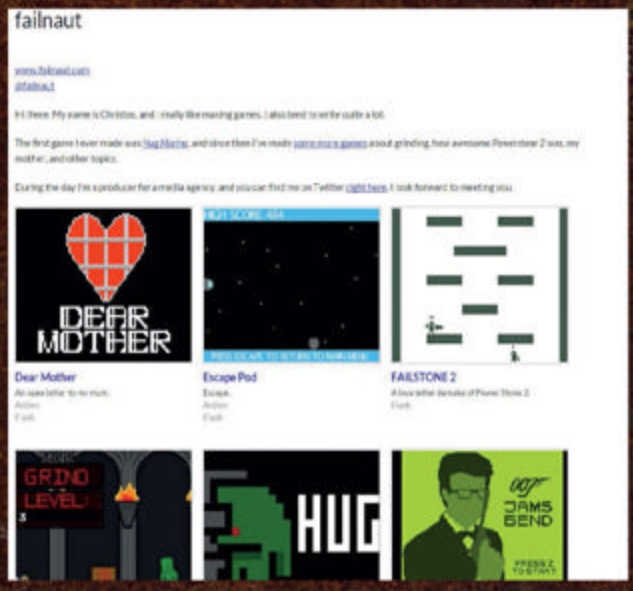
As if it wasn't already difficult for indie developers to get attention for their games, major market the European Union has changed how it taxes digital products in an especially troublesome way.

In response to scandals involving companies such as Amazon and Google paying very little tax, the EU decided firms should pay the relevant amount of sales tax for every sale in every country, rather than where they're registered or based, whatever their size. Suddenly a market for games the size of the USA promised only a mountain of paperwork.

A scheme called VATMOSS was meant to help those in the UK at least, but only applied to bigger, VAT-registered firms, which doesn't include many indies. Smaller distributors like itch.io simply said they wouldn't do the admin.

As one indie dev, Christos "Failnaut" Reid, explains, the scheme was well-motivated but not well thought-through. "Before, businesses such as Amazon have been able to duck this by running sales through Luxembourg. Now everyone pays their way."

"It was, however, dumped on a community of independent



An increasingly complex European tax system means many indie developers choose to rely on donations rather than sell games.

provides the code for networking, cloud saves, microtransactions, and a few other essential items.

Similarly, GOG is developing its own alternative to Steamworks, called GOG Galaxy. "Support for network games is actually one of the reasons we're developing GOG Galaxy," says GOG's Nalewajk. "There are a few games out there that use the tech already. That includes the recently released *Double Dragon Trilogy*, *The Witcher Adventure Game*, and *Alien vs. Predator Classic 2000*, and there is going to be a whole lot more coming up in the future."

ANALYZE THIS

A newer essential swims into focus once players have actually got their hands on your game—metrics. You want to know who's buying your game, where they're buying it from, how long they're playing for, and crucially, why they're stopping playing. Atkinson-Jones recommends Google Analytics for this as it's "really good and free," though it's more useful for tracking hits than in-game difficulty spikes.

Two more essentials are about letting the developer update the game remotely and other players mod it. Steam provides easy, free updating, while Steam Workshop provides easy-access modding support, but you still need to build it into your game and people still need to make stuff. As Atkinson-Jones says, "Modding support has two sides. The first is that your game has to support it and that's pretty much up to you. The second is where mods are stored and how you get hold of them. For very large scale games you are going to want a Content Delivery Network, like Amazon."

***Terraria* is one of the few games to have an in-built non-Steam updater.**

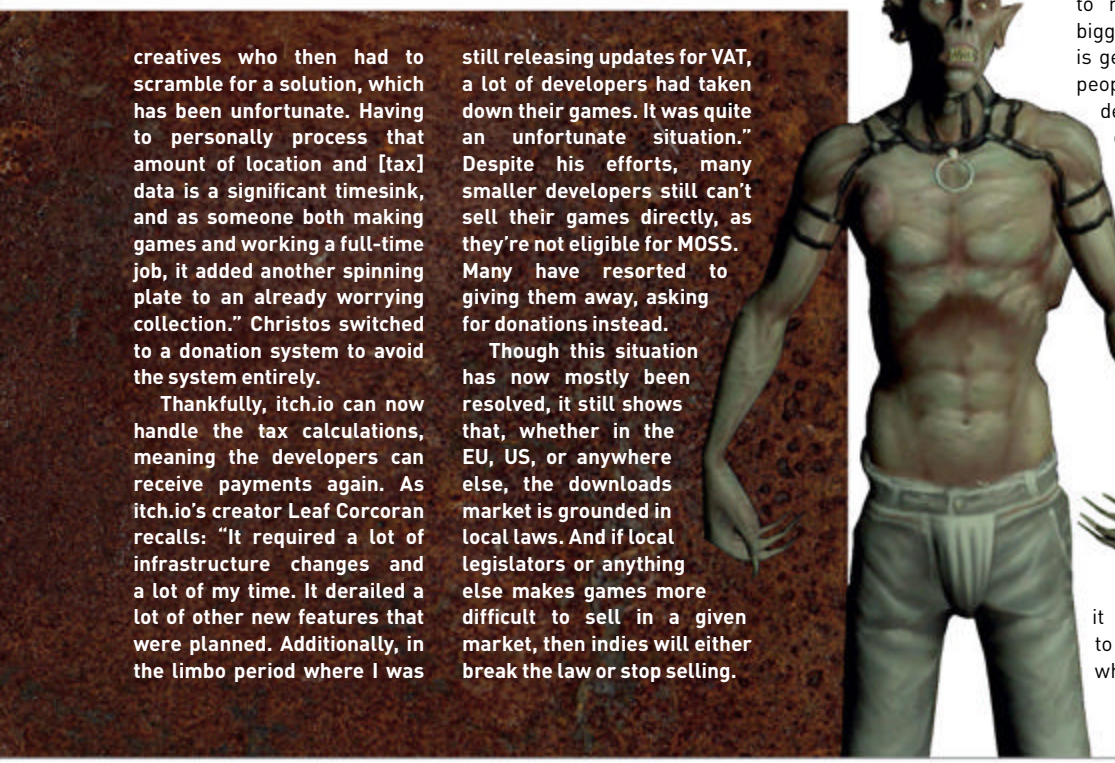
***Vampire: The Masquerade* was a pre-Steam disaster.**

A FOGGY FUTURE

It's clear there's no one-stop alternative to Steam for gamers. The wealth of titles the system offers, the competition on price, and the social network element have prevented anyone making a single competing system. The few that are functionally similar are made by game publishers and rarely publish other games.

For developers, however, there are a lot of technical alternatives, and if there's one thing indie developers know about, it's sharing information to make games cheaply. So the biggest problem for indie developers is getting sales. That means letting people know about your game and—despite the recent flood of poor-quality games—Steam remains the single location that PC gamers go for their games.

What does that mean? It means that PC gamers look first at Steam for their games. If you're a developer and want your PC games to sell, you hit Steam first. If you want to sell elsewhere, you have a lot of extra work to do—and that effort's probably better spent on porting the game to mobile or consoles, not selling through a third party or directly. So, it looks like Steam will continue to dominate, until the time comes when it chooses not to.



creatives who then had to scramble for a solution, which has been unfortunate. Having to personally process that amount of location and [tax] data is a significant timesink, and as someone both making games and working a full-time job, it added another spinning plate to an already worrying collection." Christos switched to a donation system to avoid the system entirely.

Thankfully, itch.io can now handle the tax calculations, meaning the developers can receive payments again. As itch.io's creator Leaf Corcoran recalls: "It required a lot of infrastructure changes and a lot of my time. It derailed a lot of other new features that were planned. Additionally, in the limbo period where I was still releasing updates for VAT, a lot of developers had taken down their games. It was quite an unfortunate situation." Despite his efforts, many smaller developers still can't sell their games directly, as they're not eligible for MOSS. Many have resorted to giving them away, asking for donations instead.

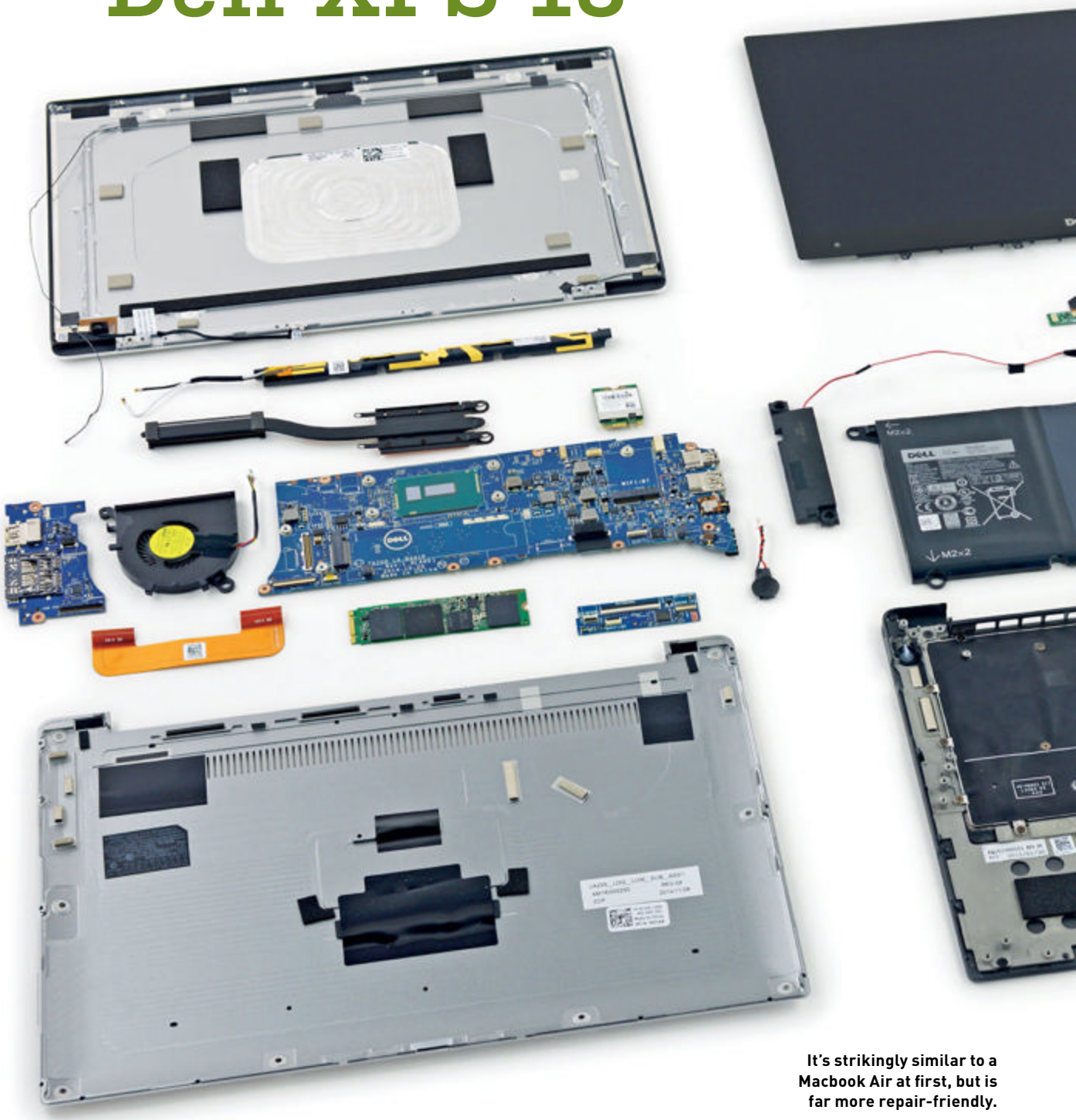
Though this situation has now mostly been resolved, it still shows that, whether in the EU, US, or anywhere else, the downloads market is grounded in local laws. And if local legislators or anything else makes games more difficult to sell in a given market, then indies will either break the law or stop selling.

IFIXIT presents:

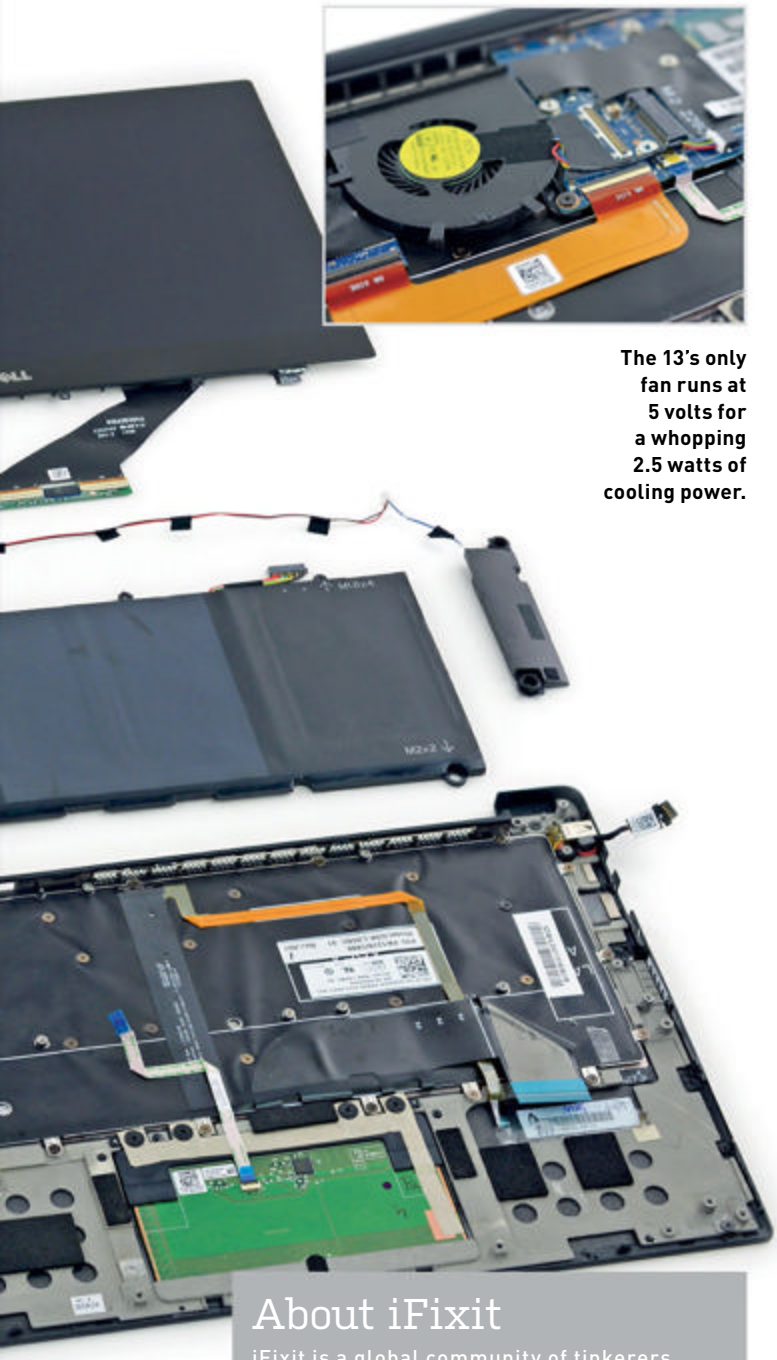
AUTOPSY

THIS MONTH WE DISSECT...

Dell XPS 13



It's strikingly similar to a Macbook Air at first, but is far more repair-friendly.



The 13's only fan runs at 5 volts for a whopping 2.5 watts of cooling power.

About iFixit

iFixit is a global community of tinkerers dedicated to helping people fix things through free online repair manuals and teardowns. iFixit believes that everyone has the right to maintain and repair their own products. To learn more, visit www.ifixit.com.

BACKGROUND:

Thirteen doesn't go into 11. It's simple math. Unless you're Dell, in which case you laugh in the face of impossible calculations, and drop ice cubes down the vest of differential equations. Or something. What we're getting at is Dell's claim to have squeezed a 13-inch display into an 11-inch notebook form factor. How is such devilry achieved? By ditching the screen bezel almost entirely, that's how.

MAJOR TECH SPECS:

- 13.3-inch "UltraSharp QHD+ infinity touch display" with 3200x1800 resolution
- Fifth-generation Intel Core i5-5200U processor (up to 2.7GHz) with Intel HD Graphics 5500
- 8GB Dual Channel DDR3L-RS 1,600MHz RAM
- 128GB SSD
- Four-cell, 7.4 V, 52Wh battery with "up to 11 hours run time."
- Broadcom DW1560 Wi-Fi/Bluetooth 4.0 LE card

KEY FINDINGS:

- Dell gives up bezels and shaves the case width for portability and to highlight the "infinite" display and full-size keyboard. Requiring two different drivers just to get the thing open has us scratching our heads, but at least we've got screws! That's better than the alternatives. We spoke too soon—there are clips, too, and hefty ones at that.
- This looks like a less-polished MacBook Air. Similar except for the repair-friendly labels on every component and connector, something you don't see in an Apple product.
- The battery connector is no easy pop-off top; it requires some precision spudgering to chase it out. After that, it still isn't a perfectly clean getaway—the speaker wires are strategically taped to the battery in a half dozen spots.
- Let's get to the fun part, the new exciting feature Dell is trying to sell here—the ultra high def, infinity-edged touchscreen display. The clutch cover comes off, revealing a plastic frame of antennas. You'd better peel slowly and use plenty of heat. That's some thin glass.
- After painstakingly cracking the clam, we find a mysterious black thread running along the inside of the top case. There's no mention in the manual, but we're betting we just stumbled onto the easy way to get the LCD out—without the pain or the staking. What an awesome repair Easter egg!
- Repairability Score: 7 out of 10 (10 is easiest to repair). Free service manuals are online. Once you get the bottom cover off, all the parts are pretty easily replaceable. Screws and connectors are labeled. Moderate adhesive—except for the display assembly, so no heat is required. The layering could be better, but the modular design makes repairs cheaper. Soldered RAM means that can't be upgraded.

We've upgraded

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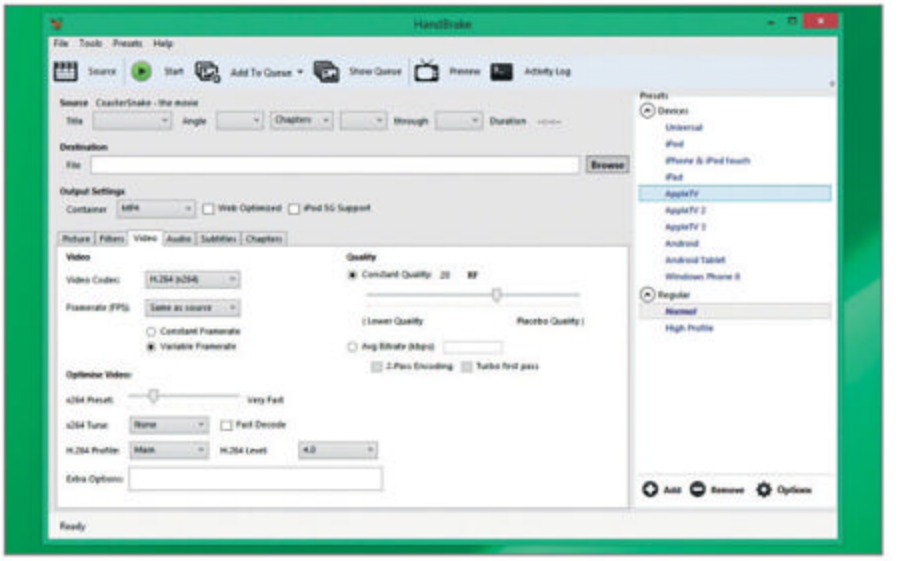
HOW TO

STEP-BY-STEP GUIDES TO IMPROVING YOUR PC

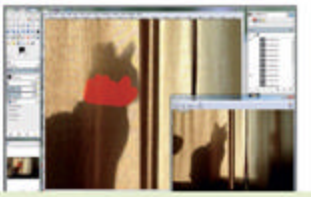
WINDOWS TIP OF THE MONTH



MAKE YOUR VIDEOS PLAYABLE ON ANY TYPE OF DEVICE WITH HANDBRAKE

Unless you're using Windows Vista, in which case DVD Maker will do the job, Windows doesn't come with anything for converting videos into files suitable for certain devices. You could download Microsoft's Windows Movie Maker (http://bit.ly/WZlaRS), but a more lightweight option is Handbrake (handbrake.fr). It has loads of ways to completely customize your movies.

MAKE – USE – CREATE



60 Set up an Instant Messenger service

64 Create your own cinemagraphs

68 Building a beefy but super-quiet rig

GRAHAM BARLOW
CONTRIBUTING EDITOR

THE PRICE OF FREE

There's a big problem with Windows freeware. It's not so much the apps themselves, it's all the crap that comes bundled with them. Download almost anything on the top 10 most popular list from a major site like download.com, for example (as How-To Geek did here: http://bit.ly/1u0kElS), and you're inviting evil browser hijacker apps to have a party in your PC, redirecting your web searches and opening annoying pop-ups.

You can avoid a lot of the pain by not accepting the default options when you install software. In most cases, you're entering a world of hurt by hitting "OK" when it asks if you want a default install. But even so, it's not always obvious what you're agreeing to install. A better solution is to track down the app's makers and download it direct—you're much less likely to open the floodgates, but there's still no guarantee.

Here's another suggestion—stop being a cheapskate and pay for your software! We all love free software, but software with a dollar price attached means the company can make an honest living without having to install something else on your PC. When it comes to PC software, the price of free is probably too high.

↘ submit your How To project idea to: comments@maximumpc.com

Set Up An Instant Messaging Service

YOU'LL NEED THIS

JAVA-ENABLED SERVER
We'll use Ubuntu and equip it with the Java Runtime Environment.

OPENFIRE SERVER
Get the open source IM server from www.igniterealtime.org.

IM CLIENT
It must support XMPP.

INSTANT MESSAGING, OR IM, is one of the best collaboration tools on any type of network. Educational institutes can use it to connect teachers with each other, as well as the students, or it can even bring together geographically displaced employees of a multinational corporation.

The Extensible Messaging and Presence Protocol, or XMPP, is one of the most popular protocols for powering an IM server—it currently serves millions of users worldwide and is also used by Google Talk. There are several XMPP-based IM servers available, but Openfire is one of the easiest to set up and use, implementing many of the commonly used functions of the XMPP protocol and scaling well. On small-scale deployments, the server can manage and support users by itself. On larger deployments, you can hook up Openfire with existing network infrastructure such as an LDAP server and offload storage to an external database server. While you can use any XMPP-compatible IM client to chat through Openfire, it works best with its own feature-rich Spark client. Here's how to set it up. **–MAYANK SHARMA**

1 PREPARE TO OPENFIRE

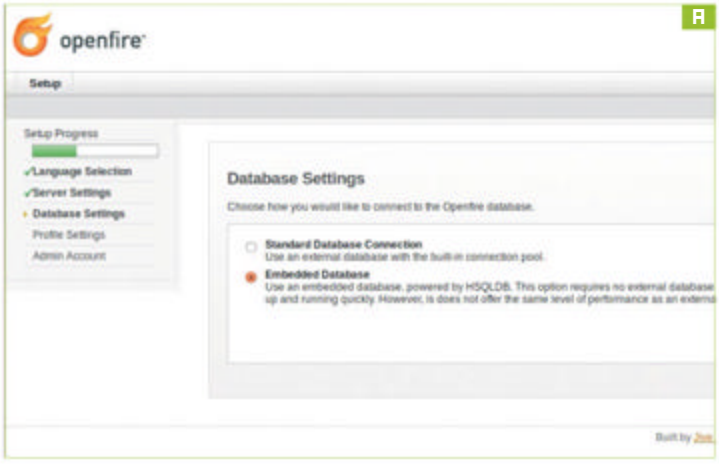
The Openfire server can be deployed on Windows, Mac OS X, and on various Linux distros, including Debian, Ubuntu, and Fedora. The latest version is Openfire 3.9.3. In this tutorial we'll deploy it on top of an Ubuntu Server installation.

» Before you can install Openfire, make sure your Ubuntu server has the latest Java Runtime Environment (JRE) that you can install from Ubuntu's official repository with the "sudo apt-get install openjdk-7-jre" command. This step isn't required if you're installing Openfire on Fedora, Windows, or Mac because the binaries for these platforms include the Java JRE.

2 COMMAND AND CONTROL

Once it's installed, download the .DEB binary of the latest version of the server—namely "openfire_3.9.3_all.deb"—from its website and install it with the "sudo dpkg --install openfire*.deb" command. That's all there is to it. The Openfire server is now installed and you can control it via the scripts that have been placed inside the "/etc/init.d" directory. You can start the server with the "sudo /etc/init.d/openfire start" command. Similarly, to stop the server use the "sudo /etc/init.d/openfire stop" command.

» Once the server is up and running, you can configure and control it from a remote machine via its browser-based interface, which you can access by pointing your web browser to port 9090 on your server. For example, if the Openfire server is on a machine with the IP address 192.168.3.100, then Openfire's web interface is at http://192.168.3.100:9090.



3 CONFIGURATION WIZARD

The first time you bring up the interface, you'll be taken through a five-step configuration wizard to set up Openfire. After selecting the language, you'll be asked to tweak basic server settings such as the domain name. You should also change the default ports for accessing the administration console. For added security you can also encrypt system properties by selecting one of the two encryption algorithms offered (Blowfish and AES) and specifying a key.

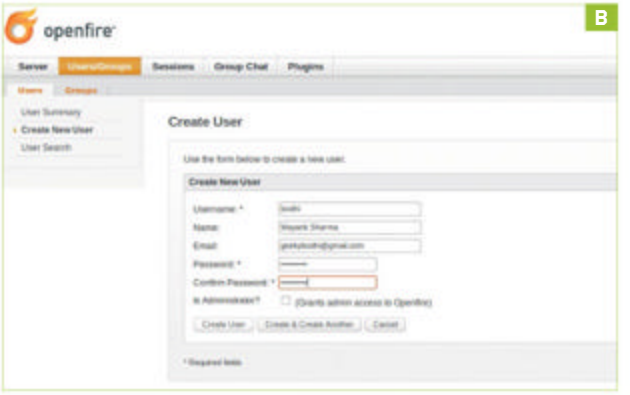
» In the next step you're asked to select a database for storing information such as user profiles and offline messages [Image A]. If you're deploying Openfire on a small network, you can choose to use the built-in HSQLDB, which doesn't require you to set up an external database server. However, if you'll be servicing hundreds of users concurrently, you should select the option to connect to an external database such as MySQL.

4 USER MANAGEMENT

In the following step you're asked to select a mechanism for fetching user authentication information. Unless you've a directory server already managing users, you should use the default option which entrusts user management to Openfire.

» In the final step you're asked for the email address of the administrator along with the password for accessing the admin interface on subsequent visits. Your Openfire server is now ready to accept connections and facilitate communications inside your network.

» If you haven't changed the port of the admin interface, you can manage the server by heading to the same address as before. Instead of the configuration wizard, you'll be greeted by a login page. Enter the username (admin) and the password you specified in the last step of the configuration wizard to access Openfire's admin interface.



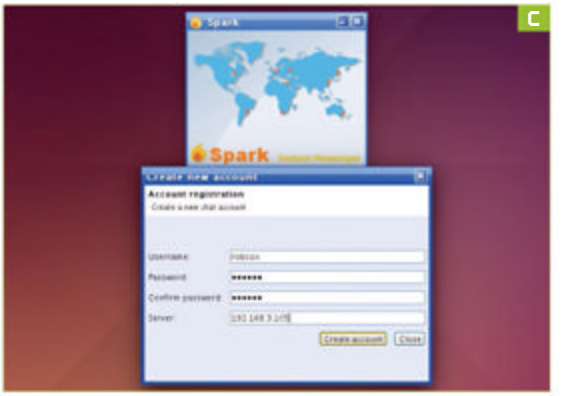
B

5 INTERACTING WITH THE SERVER

Now the server's set up, you can connect to it using an IM client from any computer on the network. Like Openfire, its companion Spark client is also available for multiple platforms and distros, including Windows and Mac OS X. For Ubuntu, you'll have to download the latest version as a compressed tarball and extract it with the "tar xvf spark_2_6_3.tar.gz -C /opt" command. There's no installation and once it's extracted you can launch the client with the "/bin/bash /opt/spark/Spark" command.

» Spark requires 32-bit Java, so if you're on a 64-bit machine and get errors about missing libraries you can install them individually, or you can install 32-bit JDK with "sudo apt-get install openjdk-7-jdk:i386." In the client, enter the login credentials of the admin user and enter the IP address of the Openfire server in the Server field, and click on the "Login" button.

» You can also connect to Openfire using other multi-protocol IM clients such as Pidgin. In addition to the login credentials and the IP address of the server, you'll also have to make sure the client uses the XMPP protocol to connect to Openfire.



C

6 POPULATE ROSTERS

At the moment, your contacts list is empty because there aren't any users on the server besides you, the administrator. There are two ways you can add users—either via the web-based administration console or from within Spark. If you prefer the first route, head to the "Users/Group" tab. To create a new user click on "Create New User" and fill out their details [**Image B**]. To better organize users you can also categorize them under different groups. To define groups, switch to the "Groups" tab and click on "Create New Group." Users can also register themselves with the Openfire server from the Spark client by clicking on the "Accounts" button and filling out their desired login details [**Image C**].

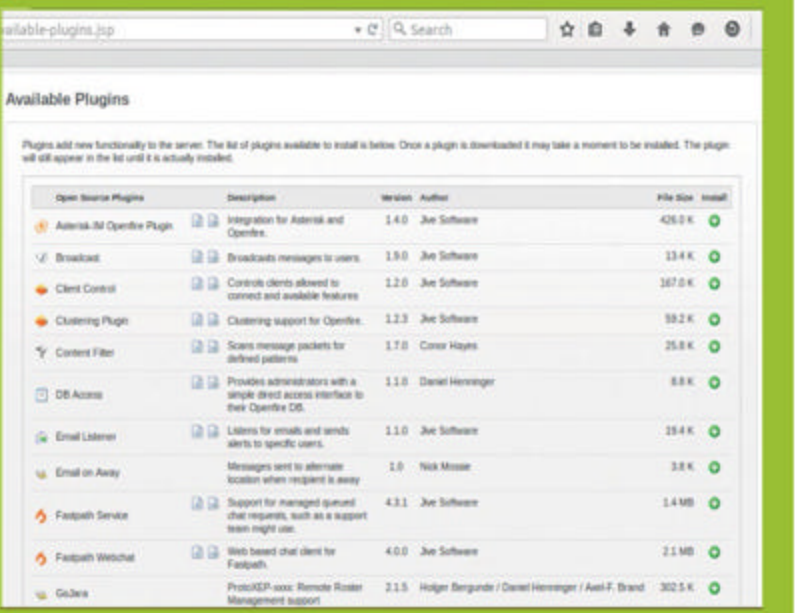
» Once you've added users and defined groups, you can use this information to populate their rosters. A roster in XMPP parlance is a friends list. With Openfire's roster sharing feature, all your users will have their co-workers already in their contact list as soon as they log in. You'll

UPGRADE WITH PLUGINS

While it's loaded with features, you can extend Openfire and infuse new functionality by adding plugins. The default Openfire installation ships with over 20 plugins that have been thoroughly tested.

There are plugins that add useful features such as the ability to broadcast messages to all users and to filter messages based on their content. Then there are plugins that help hook up Openfire to existing services on the network, such as the Asterisk PBX or an email server. When connected to an email server, Openfire will alter users on any incoming emails. One interesting plugin we've used in this tutorial is "Kraken IM Gateway." It helps users connect to public IM services such as Facebook and Google Chat.

To enable a plugin, log into the web admin console and head to "Plugins → Available Plugins" to view the list of all supported plugins. Each one has a brief description and buttons to view its "readme" file and "changelog." To install a plugin simply click the green "+" button next to it.



You can also download a handful of beta plugins from Openfire's website.

need a categorized list of groups and users for this feature to work. It doesn't matter whether you've got this information from a directory server or have created it manually in the admin interface.

7 SHARING CONTACTS

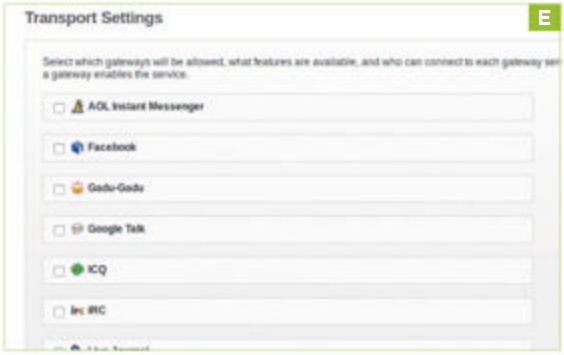
To allow members of each group to see each other, log in to the web interface and head to the "Users/Groups" section. Switch to the "Groups" section and select any group from the list. This opens the page for editing the settings of that particular group. Scroll down to the "Contact List (Roster) Sharing" section and toggle the "Enable" contact list group sharing option, then enter the name of the group in the text box. Now save the settings and repeat the procedure for all the groups on your server. Once you're done, members of a group will automatically have each other in their contact list.

» Additionally, there are certain users, for example the guys from the IT department, who you might want in everyone's roster. To do this, enable roster sharing for them just like above. But before saving the settings, toggle the "Share" group with additional users checkbox and select the "All users" option [**Image D**]. Now all users in every group will have users from IT in their contact list.

8 ADDING OTHER IM NETWORKS

By default the Openfire server facilitates communication between users registered with it. But you can also interact with users on other public IM networks such as Yahoo, Facebook, and Google Talk. For this functionality, you need to enhance Openfire by adding the "Kraken IM Gateway" plugin that allows users to connect to their accounts on external services.

D
IT
For general tech support.
Edit Details
Delete Group
Contact List (Roster) Sharing
You can use the form below to automatically add this group to users' contact lists. When enabled, this group will only appear in the contact lists of the group's members. However, you can share this group with all users or members of other groups.
Disable contact list group sharing
Enable contact list group sharing
Enter contact list group name
IT
Share group with additional users
All users
The following groups:
Accounts
Sales
Save Contact List Settings



» Begin by installing the plugin (see "Upgrade With Plugins," on page 61). Once installed, the plugin creates its own entry called "Gateways" under the "Server" section in the web admin panel.

» Using it is straightforward. To allow users to connect to a third-party IM server, head to "Gateways → Transports." This section lists all the supported IM services [**Image E**]. When you select a service it slides open a small bar at the bottom with three buttons that'll help you configure and test the gateway. You can access some settings specific to a gateway using the "Options" slider button. However, unless you're having trouble connecting, the default settings should work without any modifications. You can test the settings using the "Tests" slider button.

9 SETTING PERMISSIONS

By default, all users on the Openfire server will be able to connect to the enabled gateway service. To restrict access to certain users or a particular group, you need to head to the "Permissions" option. Here you get options to choose the users and groups you wish to connect to external services. You can also restrict the gateway to only users you've added manually.

» You can enable as many different gateways as you wish to choose, with different permission settings for each. For example, you can enable Google Talk for all users and IRC for just the IT group. Icons for enabled services appear in the user's Spark client. They can then click on the icon and enter the login credentials for the service to connect to it.

PUT INTO PRODUCTION

There's a couple of things to consider when you're ready to roll Openfire out into a live production environment. You'll have to tweak your firewall, for example, to allow Openfire traffic.

In addition to the admin console that runs on port 9090, there are some other ports that Openfire uses to facilitate communication. These include port 5222, which the client uses to connect to Openfire, and port 7777, which is used for file transfers. All ports used by the server are listed on the main page of the web admin console.

If you're running an external database server you should use it instead of the database for greater performance. Create a database for Openfire in your database server and then populate it by using the appropriate database schema from under the Openfire installation ("/usr/share/openfire/resources/database/"). Openfire ships with database schemes for several databases, such as IBM's DB2, PostgreSQL, Microsoft's SQL Server, and more.

You'll also want to connect the Openfire server to a directory server such as OpenLDAP, if you've one running on your network. You need to know the hostname or IP address and the port of the machine the directory server is running on, its BaseDN, and the authentication information.

You should then re-run the Openfire setup wizard by editing the "/etc/openfire/openfire.xml" file and changing "←setup→false←/setup→" to "←setup→true←/setup→." Now select the Directory Server button in the profile settings step and enter your server's details. Once Openfire connects, you can pick the elements used to populate the user's IM profile.

Record Skype Calls On Your PC

YOU'LL NEED THIS

PAMELA
An easy-to-use app that works well with Skype. Download if for free from www.pamela.biz.

SKYPE IS AN AMAZING TOOL, but it's missing a few features—most significantly the ability to record your conversations and video chats. Call recording can be enormously useful for video conferencing, seminars, and interviews—in other words, basically any situation where you need to keep a note of what's being said, but want to listen and participate rather than keeping your head down and scribbling in a notepad.

Be aware that the recording of communications is covered by both state and federal wiretapping laws in the US. Federal law requires at least one of the parties taking part in a call, including you, to be informed that it's being recorded, while numerous states require the consent of all parties involved on the call. It's always best practice to announce at the start of the call that it's being recorded. See http://bit.ly/1kniqVg for more information. **–CAT ELLIS**

1 GET THE RIGHT SKYPE

Make sure you have the latest Skype for Windows Desktop installed (Pamela won't work with the Win8 modern app). Visit www.skype.com and click the green button in the center of the page, then select "Get Skype for Windows Desktop." Follow the instructions to download and install. Log in using your Skype or Microsoft account.

2 MEET PAMELA

Now visit www.pamela.biz and click "Products" (don't choose the "Download" link from the homepage). The Products page lists various versions of the software, but the free Basic edition offers everything we need, so click "Download now" in the gray column on the left [Image A]. You can always upgrade later if you decide you want more features.

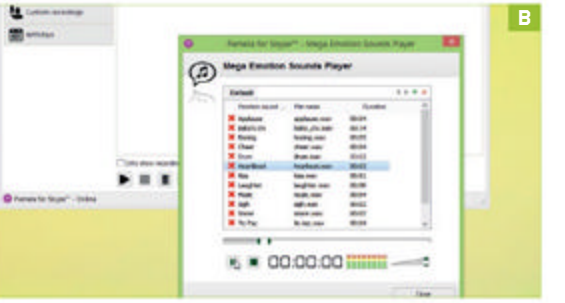
3 INSTALL THE APP

Click "Save file," then click your web browser's "Download" button and select it. Choose a language, then follow the on-screen instructions to install Pamela. At the end of the installation, you'll be asked if you want to see some special promotions—click "No." You can now use the new icon on your desktop to open the program, ready to record.

4 SKYPE, MEET PAM

Once you've opened Pamela, fire up Skype for Desktop. Skype will detect Pamela and display a message at the top of the window offering to show you how third-party apps work with Skype. The next time you make or receive a Skype call, Pamela will ask if you want to record (video or just audio). Use the buttons in the menu bar to start, pause, or end recording.

A



B

5 TAKE A NOTE

Pamela includes lots of functions to help you make the most of your recordings. For example, if you click the notepad icon at the bottom of the window, you can add notes to help you refer back to them in future—ideal if you're recording meetings or seminars. You can use the buttons at the bottom to initiate a Skype chat with the person you recorded, or start a new call.

6 MAKE SOME NOISE

It's not all work though—Pamela has some fun functions built in too, including an audio equivalent of the emoticons used to express feelings in text messages [Image B]. Click the speech bubble containing a musical note in the top menu bar and you'll see a list of sound effects that you can play during a call. Be careful though—many of them could be interpreted as sarcastic!

7 TALK TO YOURSELF

If you just want to record your own voice (to dictate notes while you work, for example), click the microphone icon in Pamela's top menu bar to activate Custom Recording. This will record audio from your PC's microphone, with the advantage that you can add notes and file it away. You can also record video footage from your webcam by clicking the camera icon. Pamela also includes "enhanced mood" functions, plus a few other surprises, so check out the help files to see how much more it can do.

Make Your Own Cinemagraphs

YOU'LL NEED THIS

GIMP 2.8
GIMP is rough around the edges but surprisingly powerful. Get it for free at www.gimp.org.

CAMERA AND TRIPOD
Anything that shoots video, from your phone to a high-end DSLR.

TRADITIONAL ANIMATED GIFS are all well and good, but there's a newer, much classier kid on the block. Cinemagraphs are still animated GIFs, but with a more artistic, photographic twist. A good cinemagraph resembles a still photograph, with just a small part of it animated. It's a fantastic way to draw the viewer's attention to a certain area of the image, or to surprise them when an apparently still picture comes briefly and unexpectedly to life. You can see some great examples here: http://bit.ly/1MiF1AD.

Fortunately, making cinemagraphs is straightforward. We're going to show you how to do it using GIMP 2.8. If you have Photoshop then don't worry, the workflow is almost identical—just use Photoshop's "Video frames to layers" option and then use the Photoshop equivalents of the editing techniques we use here. The results can be phenomenal. –JIM McCAULEY

1 GET SOME VIDEO

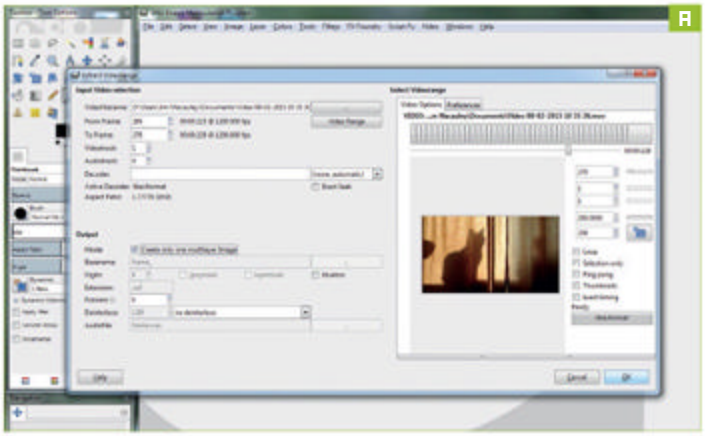
First up, we need some video to work with. If you're going to shoot your own, then there are a few rules to observe. Always use a tripod (because you need your video to be rock-steady), and frame and compose your shot as if you're taking a photograph. And, of course, make sure your video features some movement.

2 GIVE IT A TRIM

Your footage probably needs a bit of a trim. We've used Avidemux—http://fixounet.free.fr/avidemux/—because it's free and gets the job done. You open up your video, set an "in point" and an "out point" and save. You might also want to use it to reduce the saturation so that your cinemagraph still looks good when reduced to 256 colors, in which case be sure to set the Video Output option to something other than "Copy." We're using H264.

3 INSTALL GAP

We'll need to install the GIMP Animation Pack before we can import video. You can find it here: http://bit.ly/1zZKeqB. Click the blue "Download" link in the right-hand column. Unzip it, run the installer, and unpack everything to a handy folder. You'll then need to copy everything from "/lib/gimp/2.0/plugins" to your GIMP plugins folder, probably "C:/users/←your username→/.gimp-2.8/plug-ins." Then copy everything from "/share/gimp/2.0/scripts" to "C:/users/←your username→/.gimp-2.8/scripts." Once that's done, start up GIMP and marvel at the new Video menu.


A

4 IMPORT YOUR VIDEO

Now the fun can begin. Go to "Video → Split Video into Frames → Extract Videorange" and load your footage, then click "Video Range" to comb through your clip, frame by frame, so you can import video frames as layers. Find a good start and end frame (you'll want to make sure that the two frame match up visually), and enter their numbers in "From Frame" and "To Frame." Set Audiotrack to "0" (because we don't want any audio) and under Output, tick "Create only one multilayer image." Finally, click "OK" to import your frames [**Image A**].

5 ANIMATION BASICS

All being well, you should now have a stack of frames in your Layers panel that'll make up the basis of your animation, running from bottom to top. You'll notice that by each frame's name is a time in brackets. This is the length that each frame will be displayed in milliseconds. You can double-click and edit this length to make frames appear for longer or shorter amounts of time.

6 FRAME PREPARATION

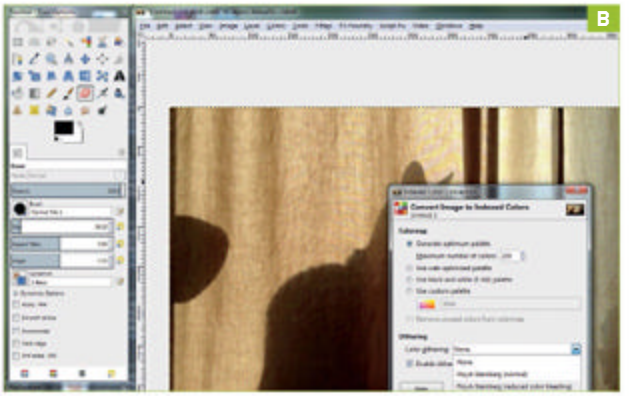
Make your top layer invisible and set the bottom layer to visible; this is the base layer of your cinemagraph and will form the static backdrop for the animation. Now you'll need to work through all the other frames, right-clicking and selecting "Add Alpha Channel," for reasons that will become clear in a bit.

7 MASK THE ACTION

If you haven't already done so, you now need to decide which bit of your cinemagraph you want to be animated. Got it? Good. Hit Ctrl-A to select all, press the "Quick Mask" button in the bottom right-hand corner, then use the Paintbrush tool to paint over the animated area. You should then work through the other layers, making them visible in order to add bits where the animation has moved outside of the mask.

8 TRIM THE EXCESS

You'll now have a mask that covers the full extent of the animation. Click the "Quick Mask" button again to create a selection, and work through all the layers



except the background, pressing Ctrl-X to delete the static area from each frame. This is when you'll realize if you've forgotten to add that alpha channel. Without it, you'll turn the deleted area white instead of transparent.

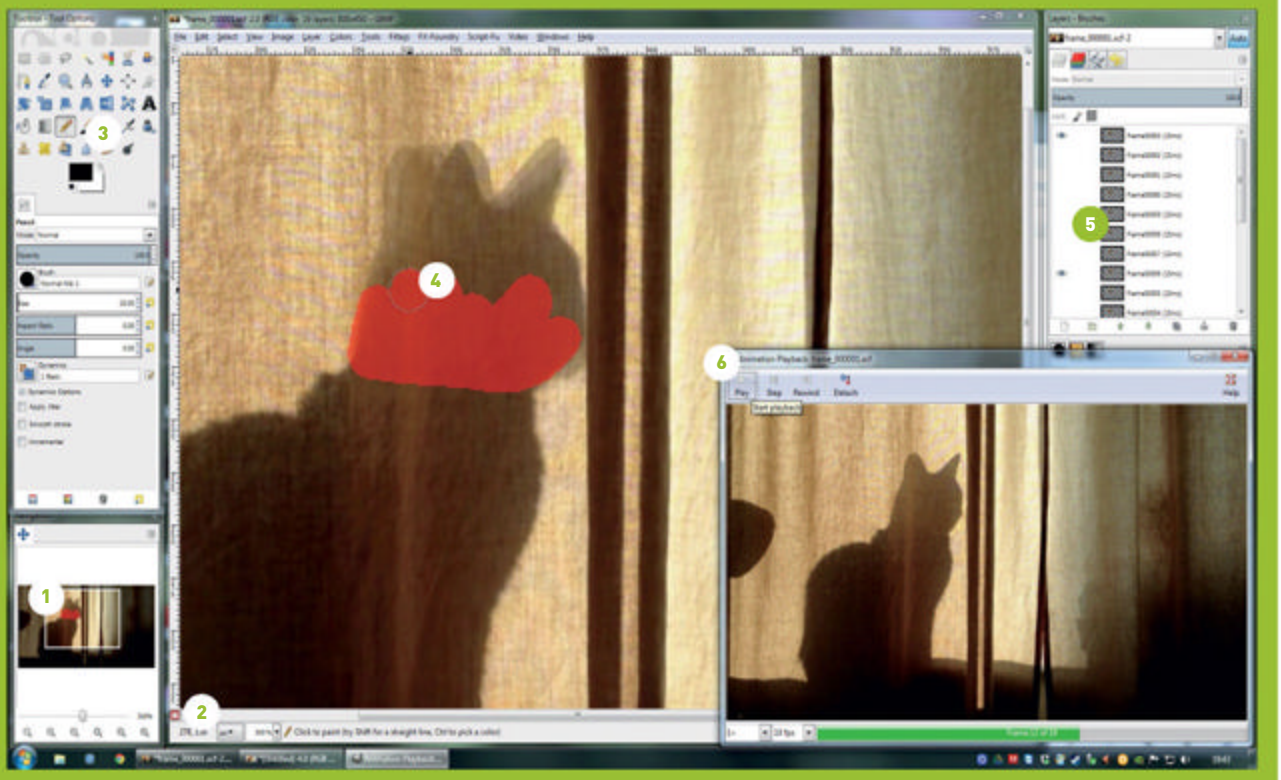
9 FINE TUNING

Make sure all the layers except the background are invisible, then select "Filters → Animation → Playback" to preview your cinemagraph. Doesn't loop smoothly? Try making it play backwards and forwards using this Mirror Layers script: http://bit.ly/1DliDT0. Or, for a smooth animation, try pasting the first frame into the last few frames at an increasing amount of opacity.

10 EXPORT YOUR CINEMAGRAPH

Now to finish off. Resize your image to something between 600 and 800 pixels wide, so it's not an enormous file. Go to "Image → Mode → Indexed," select "Generate optimum palette," and use some form of dithering, probably "Floyd-Steinberg (reduced color bleeding)," but try them all [Image B]. Check "Enable dithering of transparency," hit "Convert." Then select "File → Export," and save it as "←filename→.gif," making sure you tick "As animation" before you hit "Export." That's it! Simply drag the file into a web browser to see it in action.

ON THE MOVE



1. NAVIGATION
GIMP's navigation window provides an easy way to move around your image and zoom in on details if you need to work close up.

2. QUICK MASK BUTTON
You might be used to the Lasso tool, but the Quick Mask is ideal for creating odd-shaped selections that would otherwise require loads of fiddly clicking.

3. DRAWING TOOLS
We're not doing any actual drawing. Instead we're using the drawing tools to create our mask, it's quick and precise and you can fine-tune with the eraser.

4. MASK
Here we're masking out the part of the cinemagraph we want to be animated. We'll then delete everything else in each of the frames.

5. LAYERS
These layers form each frame of your animation. You can adjust the timing of each one by simply editing the number in brackets.

6. PLAYBACK
Check how your cinemagraph is coming along with the playback window. Play, adjust, and play again until you're completely happy.

Make Your Desktop A Thing Of Beauty

YOU'LL NEED THIS

RAINMETER
Download the desktop customization tool for free from rainmeter.net.

THE WINDOWS INTERFACE might be nice enough, but we all have different ways of working. Rainmeter is a powerful yet easy-to-use system that enables you to customize your Windows desktop with widgets that display to-do lists, calendars, weather, system statuses, and other useful information. If you want something quick and easy, then you can simply install and customize a ready-made suite. If you want more, you can hunt around for the perfect skin combination to create your own unique setup.

There are two main reasons to use Rainmeter—beauty and function. A community has grown up around the software and many people have created stylish suites that are available to download and use for free. Once you've transformed the aesthetic of your desktop, you can add the functionality that fits your way of using your computer. –TANYA COMBRINCK

1 DOWNLOAD RAINMETER

Point your browser at rainmeter.net, click the download link under "Final Release," and run the installer. You can then choose the standard installation. It's best to leave the default options in place unless you have a very old PC, in which case you should choose "32-bit."

2 LEARN YOUR WAY AROUND

The first things you'll see are a few simple skins on your desktop from the "illustro" suite. There's a clock, some system monitors, and a welcome skin. To get rid of the welcome skin, simply right-click on any skin and choose "illustro → Welcome → Welcome.ini" [**Image A**]. You can just repeat this process if you want to bring it back.

3 DISPLAYING SKINS

You'll notice the illustro menu item contains options for several other skins: a Google search box, a Recycle Bin, and more system monitors. You can make them visible using the process in the previous step. They appear on top of one another in the top-left corner and can be dragged to new positions.

4 INSTALLING NEW SKINS

We're now going to install one of the most popular skin suites, Kaelri's Enigma. Go to http://bit.ly/1iXJGMZ, download Enigma, and run the installer. Now right-click any skin and choose "Rainmeter → Layouts → Enigma Preview" to see the new skins [**Image B**]. If you have trouble, choose "Rainmeter → Manage → Refresh all" and retry.

5 DELVING INTO ENIGMA

You can now work through the icons on the left of the "Options" dialog to customize any details you want to tweak. Deselect the "Options" dialog in the Enigma menu when you're finished, along with any skins you don't want to use. Right-click any skin and choose "Edit skin" if you want to adjust its behavior.

6 BEYOND ENIGMA

Now we're going to grab some other skins. Head to http://bit.ly/17tj0iX and install "Arcs," which is a graphical system monitor and clock. It should display automatically. Right-click and choose "Arcs → Legend" to see a diagram explaining what it all means. You can also opt for "Darks Arcs" if you prefer that color scheme.

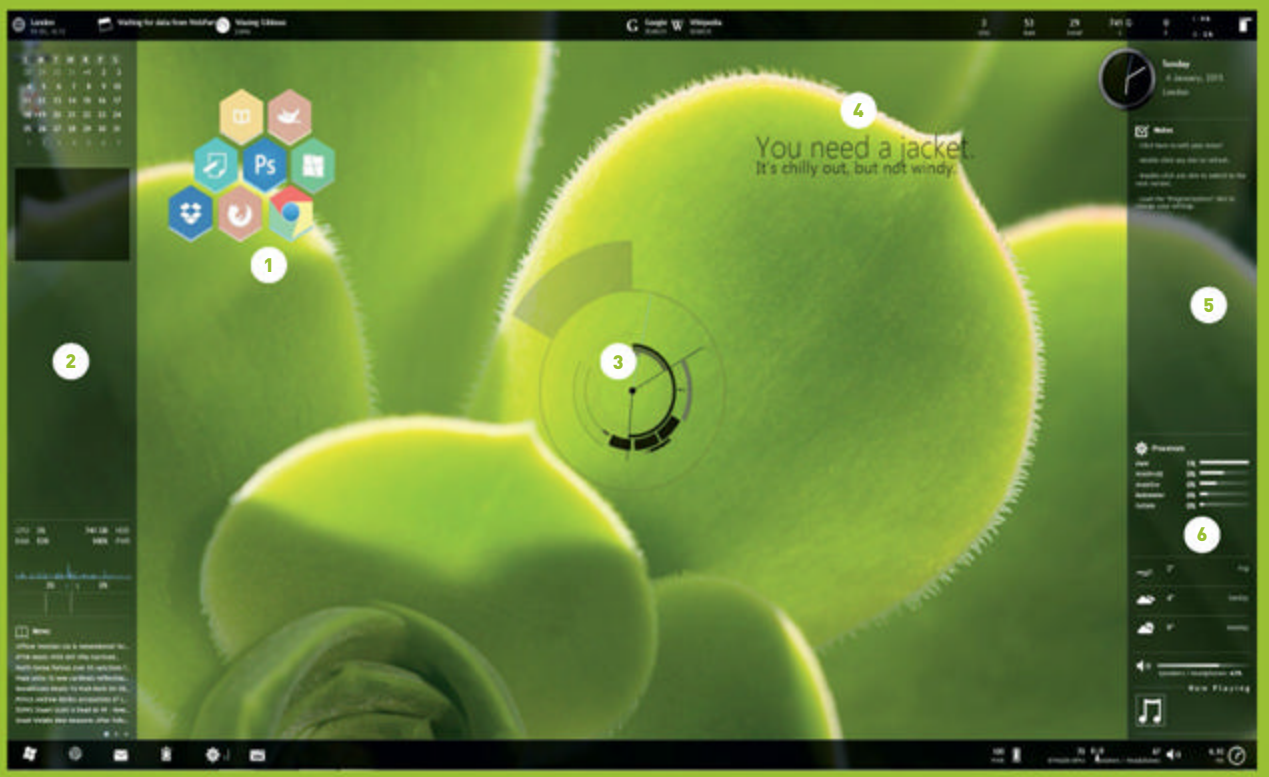
7 WINDOWS TWEAKS

We reckon the Windows Taskbar is cramping our style a bit, so right-click it and select "Properties → Auto-hide the taskbar." You may have to restart Windows before the Enigma Taskbar moves down. Also head to Control Panel and select a more interesting background to go with your sleek new desktop.

8 SKIN HUNTING

One of the best places to find more skins is rainmeterhub.com [**Image C**], as well as on rainmeter.net/discover. Do your research when installing

SHOWING SOME SKIN



1. HONEYCOMB
The Honeycomb skin provides icons for a library of applications that can be arranged into a honeycomb. Go to rainmeterhub.com/skins/honeycomb.

2. THE ENIGMA SUITE
Everything you see around the edge of this desktop is from the Enigma suite, which is a collection of skins designed to work together.

3. ARCS
This stylish collection of arcs and circles houses a clock and system monitor that matches the Enigma suite.

4. YOU NEED A JACKET
For when looking out the window is simply far too much hassle. Get friendly clothing recommendations from your desktop with this skin that offers advice based on information from Yahoo weather.

5. EDITING SKINS
Right-click a skin and choose "Manage Skin" to bring up an options dialog. From here you can edit settings and "Unload" items you don't want.

6. PROCESSES
This handy and discreet skin displays currently active processes, so you can see at a glance what's eating up your PC's system resources.

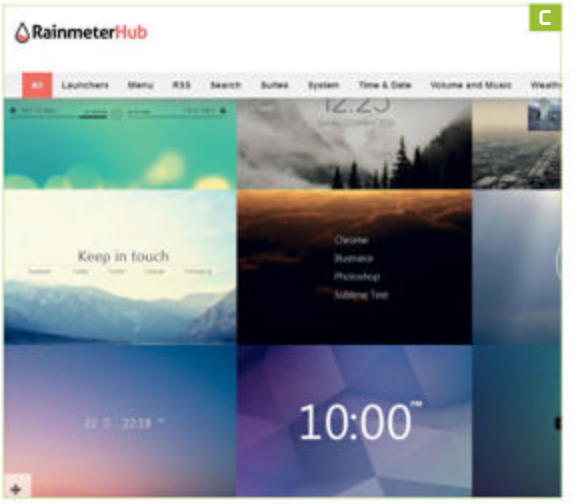
skins, as sometimes people hide malicious programs inside them. It's also a good idea to install an ad blocker, otherwise you'll see a lot of confusing download links.

9 MIX AND MATCH

Next we're going to add a weather skin that recommends what you should wear before venturing outside. Get it from rainmeterhub.com/skins/need-jacket/. Hover over the skin and click the cog to open its settings file, where you can change the font and the thresholds for its jacket advice. The question mark icon gives you instructions for entering your location.

10 SAVING LAYOUTS

Once everything's as you want it, you should save your setup as a layout. Right-click a skin and choose "Rainmeter → Manage" and go to the "Layouts" tab. Enter a name and click "Save," checking the wallpaper box if you like. Now your layout will appear in the "Rainmeter → Layouts" menu so you can always go back to it.



BUILD IT

TOM MCNAMARA **TECHNICAL EDITOR**

Creating A Quiet But Beastly PC

Low noise doesn't mean low joys

LENGTH OF TIME: **2–4 HOURS** | LEVEL OF DIFFICULTY: **MEDIUM**

THE MISSION

OVER THE LAST FEW MONTHS, in the creaking depths of the secret *Maximum PC* lair, we've been constructing compact PCs or just putting shiny new things together and seeing what they do. And that's usually pretty entertaining. But it occurred to us that it's been a good while since we tackled a quiet PC build. After all, as much as we like raw power, we don't want to hear that power all day long.

But that doesn't mean we need to sacrifice performance. If we create a whispery rig, we can still build it to growl and roar in its own way. And it's not as difficult as you might think. With the right case, CPU cooler, and videocard, everything can fall into place. Luckily, the hardware components market is chock-full of interesting possibilities, one of which was so new that it hadn't even been reviewed as this issue went to press. We entered this undiscovered territory, and we think it was worth the journey. This build didn't turn out quite the way we expected, but a little ingenuity made it come together in the end.

ARMED TO THE TEETH

THE MOST IMPORTANT ELEMENT of a quiet PC build is the case. You want to keep the racket down, and that means sound-absorbing panels. You can glue your own in, or you can buy cases with panels pre-installed. Last time, we used a Fractal Design Define R4, which is still a fine choice. But we needed something with more airflow (the R4 comes with only two fans). Enter the NZXT H440. We decided to go a step further and get the Razer edition, which is almost all black, save for a few neon-green details. It has three 120mm intake fans, a 140mm exhaust fan, and space for a large radiator up top. It fit the bill. The radiator belongs to the Corsair Hydro H110i GT. This has a 280mm rad, thick tubing, and some nice aesthetics.

The H110i will be cooling an Intel Core i7-5960X. Like we said, we're not holding back. This 8-core, 16-thread chip is a monster for things like video editing and virtual machines, and we can overclock it quite a bit with the H110i. This hefty CPU sits on an Asus X99 Pro motherboard, which is a premium, feature-packed job. Along for the ride is 32GB of Corsair Dominator DDR4, a 960GB OCZ Vector 180 SSD, a 6TB hard drive from HGST, an MSI R9 290X Lightning, and a Corsair AX1200i power supply. Ladies and gents, we do not mess around. Read on to see how this epic stack of gear comes together.

INGREDIENTS

PART		PRICE
Case	NZXT H440 (Razer edition)	$150
PSU	Corsair AX1200i 1,200W	$300
Cables	Optional Corsair Cable Kit (White)	$100
Mobo	Asus X99 Pro	$320
CPU	Intel Core i7-5960X	$1,050
GPU	MSI R9 290X Lightning	$333
RAM	4x 8GB Corsair Dominator DDR4	$660
HDD	6TB HGST UltraStar He6	$460
SSD	960GB OCZ Vector 180	$500
OS	Windows 8.1 64-bit OEM	$100
Total		$3,973

1 POWER BEHIND THE THRONE

THE POWER SUPPLY finds its cosy new home in a separate chamber at the bottom of the case, and it gets in there by sliding in gently through the back of the case, instead of coming in from the side as it usually would. To make that happen, you have to first remove this plate, which is held down by four thumbscrews. Then you slide your PSU in, put the plate back on, and screw the plate into the PSU.

If you're using a modular power supply, like we are for this month's build, you also need to hang back and attach your cables before you get going with sliding the PSU in. That's because the back of the PSU will be difficult to reach past this point. It's a bit of pain, but that's always going to be one of the drawbacks of a clean-looking case.

2 GOING TO GREAT LENGTHS

INTERESTING HURDLES show up right away. We've put the mobo's I/O shield in, screwed the motherboard into the case, and installed our RAM sticks, when we notice the videocard is longer than expected. Thankfully, we can remove a drive tray in the front to make room.

It's attached with two thumbscrews and slides right out. But connecting the power cables is tight, even when you use these flexible ones. That's partly because this card is also taller than usual. If it used the reference height, then regular rounded cables would probably be fine. Also note this card uses an extra 6-pin cable. Our 8-pin cables come with two detachable pins, so we took the cable with the bonus pins and tucked it out of the way. There's a side window, so we want it looking tidy.

3 UNO, DOS, TRAYS

THERE ARE TWO TRAYS on top of the power supply compartment where we could have put our solid-state drive, but we like hiding it out of the way. You may have noticed by now that the H440 has no 5.25-inch drive bays. This cage has only 3.5-inch trays, which can also take 2.5-inch drives. After making room for the videocard and the CPU cooler, we had three trays left. We took the two that were closest to each other and used them for the SSD and the HDD. That allowed us to use one SATA power cable (which also connected to the CPU cooler). The drive attaches with a set of small bundled screws.

4 SOMETHING UP OUR SLEEVE

OUR FANCY INDIVIDUALLY SLEEVED CABLES came in handy behind the motherboard, because there wasn't as much space back there as we would have liked. The sound-absorption panel takes up a few millimeters in an already-challenging space. Thankfully, there was plenty of room in front of the power supply to tuck things out of the way, and we'd removed two drive trays for some more space. Since the drive cage in the front of the case is hidden by a large metal plate, we were able to use that to our advantage and obscure most of the mess.

We also made sure to install the 8-pin CPU power cable before installing the CPU cooler. Otherwise, the cooler's radiator and fans would have blocked our path. We also needed to whip out a Molex cable to power the hub that the case fans were connecting to. The fans themselves were hooked up to the hub at the factory, so that saved us some time and energy.

5 JOINING THE FAN CLUB

THE H440 CASE can take up to two 140mm fans on top, and up to three 120mm fans. But because of the contour of the frame, you can't set the radiator right against the metal. It's too tight. You have to put the fans in between the case and the radiator, which can be pretty tricky if you haven't tried it before. Getting the screws to line up correctly with the holes in the fans and the rad is a time-consuming process.

We have the fans facing upward so that they will pull the heat rising off the rad and send it out the vent in the panel that will sit on top of the case. The fans also need to be oriented so that their cables come out at the same location. This makes cable management much cleaner once the fans are hooked up to the cooler. You just tug the cables gently back behind the motherboard until you run out of slack.

6 TWO CAN PLAY THIS GAME

THE H440 HAD ROOM for pretty much everything we threw at it, but there wasn't space to add two more fans to the radiator. This is pretty normal for a mid-tower case. What we didn't expect is just how tight our fit would be. There's literally 1 to 2mm between the radiator and the mobo's rear I/O shroud. Because of this limitation, the radiator tubes had to be placed on the other end, and putting another set of fans on the cooler was out the window.

The side effect was that installing the CPU cooler with the Corsair logo right-side up was difficult to do in a way that looked natural. So we ended up with the logo upside-down. Not a big deal, and it has no impact on performance. We chalked it up to a learning experience. We've seen this case accommodate two extra radiator fans before—it's just not going to work with this particular motherboard.

1 The rubber grommet we're feeding the motherboard power cable through is at about a 30-degree angle, so your cable doesn't have to bend as much as usual.

2 For reference, this videocard is about 12 inches long and takes up three slots. It's a big mother. If you have a dual-slot card, there's still space to add a second one below.

3 This panel is a 2.5-inch drive tray held down by a thumbscrew. There are gaps behind it where cables can go in and out.

4 These feet elevate the case so that the power supply's intake fan gets enough clearance to do its thing. There's also a slide-out filter under here.

CONQUERING THE QUIET LIFE

AS WE'RE PREPARING THIS ISSUE for the printers, OCZ informed us it was pushing back the release date of its Vector 180 SSD, due to unspecified technical problems brought to its attention by people it had sent these units to for review. It was too late for us to re-build, re-benchmark, and re-photograph, so you'll have to visualize your favorite SSD in there instead. The good news is that SSD selection has a negligible impact on our set of benchmarks.

Speaking of performance, we were impressed by how easily the Asus X99 Pro overclocked this CPU. An OC from 3GHz to 4GHz at 1.3 volts is nothing to sneeze at, but this board needed no tweaking beyond our initial set of adjustments, which was mostly just beefing up the power sent through the voltage regulators. Not many programs use 16 CPU threads, which is why this chip wrecked our zero-point machine's stock-clocked hex-core i7-3930K in some tests, but not in others. The 5960X got into the low 80s Celsius during our Premiere Pro bench, indicating there wasn't much wiggle room left. You'd probably need a custom water cooling loop to push performance much further.

But let's not forget why we built this system to begin with: quietude. Well, plugging the fan hub directly into the power supply will create some noise, and there's no fan speed controller. And the CPU cooler's fans are also right underneath the top panel, instead of the radiator getting sandwiched in between. So the Fractal case we mentioned earlier still has some better options for noise level, and more space behind the mobo for cable routing.

Still, the case's stock fans aren't loud, and the sound-absorbing panels do muffle some noise, though the window on the side panel has an acoustic cost as well. If low noise is really important to you, we'd recommend the Define R4, though it needs at least one more fan for good airflow. The MSI Lightning card, with its monster three-fan, triple-slot cooler, hardly rose above a mild drone throughout testing, yet it still punched above its weight in *Batman: Arkham City*. The 290X is a great GPU that performs within range of an Nvidia GeForce GTX 980, but for less money.

Overall, we enjoyed wrangling this build into shape, and we were gratified to get solid, stable overclocks without needing hours of experimenting and fine-tuning.

BENCHMARKS

	ZERO-POINT	
Premiere Pro CS6 (sec)	2,000	1,263
Stitch.Efx 2.0 (sec)	831	753
ProShow Producer 5.0 (sec)	1,446	1,328
x264 HD 5.0 (fps)	21.1	31.8
Batman: Arkham City (fps)	76	91
3DMark 11 Extreme	5,847	5,005 -17%

0% 5% 10% 15% 20% 25% 30% 35% 40% 45% 50% 55%

Our current desktop test bed consists of a hexa-core 3.2GHz Core i7-3930K 3.8GHz, 8GB of Corsair DDR3/1600, on an Asus Sabertooth X79 motherboard. We are running a GeForce GTX 690, an OCZ Vertex 3 SSD, and 64-bit Win7 Pro.

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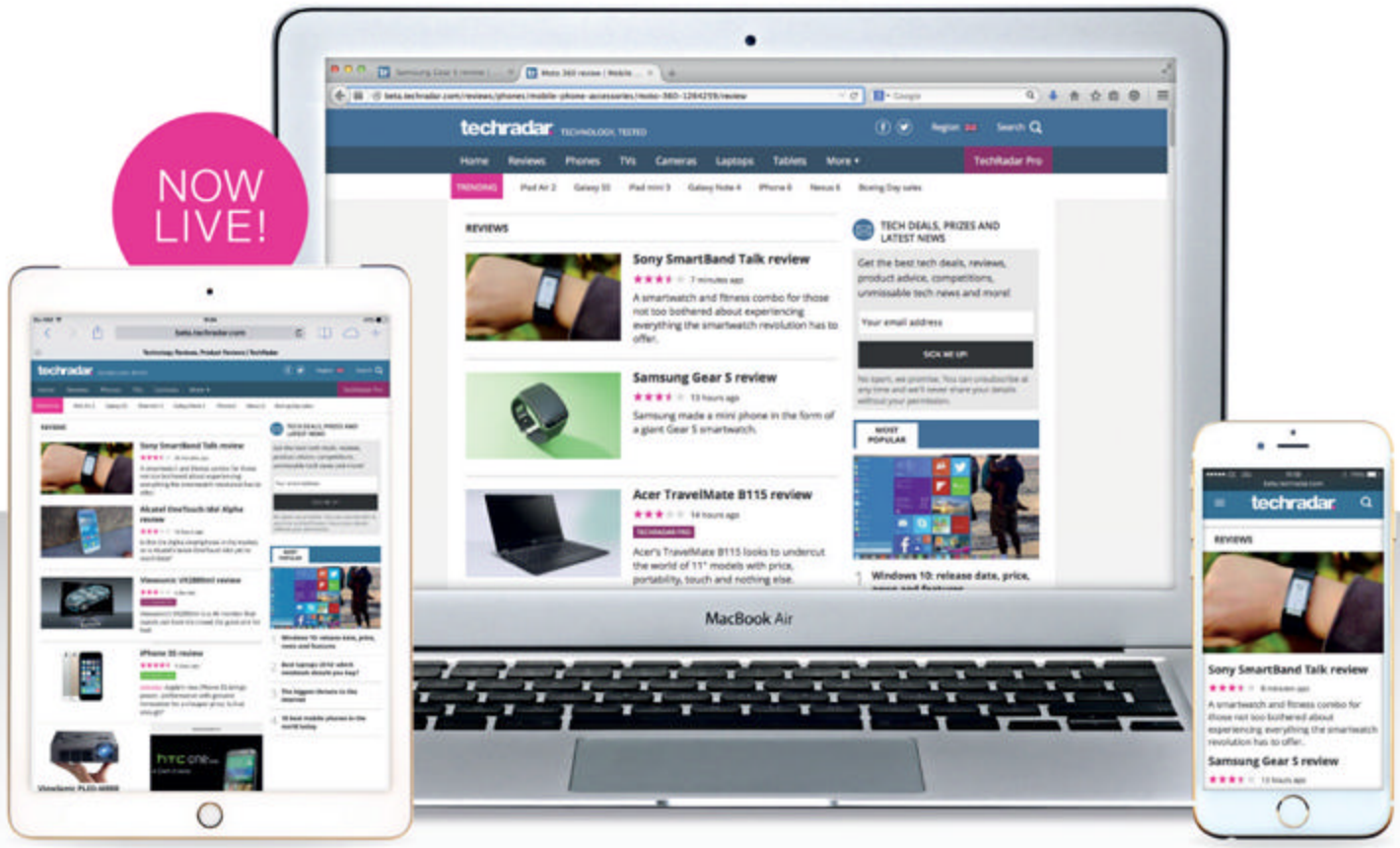
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REVIEWS
Sony SmartBand Talk review
A smartwatch and fitness combo for those not too bothered about experiencing everything the smartwatch revolution has to offer.
Samsung Gear S review
Samsung made a mini phone in the form of a giant Gear S smartwatch.
Acer TravelMate B115 review
Acer's TravelMate B115 looks to undercut the world of 11" models with price, portability, touch and nothing else.
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REVIEWS

TESTED. REVIEWED. VERDICTIZED.

INSIDE

74 CyberPower PC Syber Vapor
76 Gigabyte BRIX S
79 Fractal Design Define R5
80 Corsair Hydro H110i GT
82 MSI GS30 2M Shadow with Gaming Dock
84 Asus G751JY
86 Samsung 850 EVO M.2 500GB
88 Dying Light
90 Sunless Sea
92 Lab Notes

CYBERPOWER PC SYBER VAPOR
PAGE 74

CyberPower PC Syber Vapor

A Steam box for the enthusiast

MUCH LIKE WHAT ALIENWARE DID with its Alpha console, CyberPower PC is transforming its Steam Machine into a Windows box, branding its new line of PCs under its Syber Vapor line. Unlike the Alienware Alpha, however, there's no proprietary 10-foot UI here.

Instead, the Vapor boots directly into Steam's Big Picture Mode. CyberPower PC is billing the Vapor as "the ultimate PC gaming console," and with some minor quibbles aside, we think the company makes a pretty compelling argument. We had very few issues with the Vapor, the biggest of which was its size. At 13.8 x 13.5 x 3.8 inches, it's much too large for backpacks. The portability problem is exacerbated by the Vapor's weight—at 15 pounds, it's very heavy.

While it's a bit larger than Microsoft's Xbox One, it looks more like a console than a PC. The version we got is white with black trim, and it also comes in an all-black chassis. Both color variants offer LED lights on the front, with six color schemes and an auto-cycling mode to choose from. There's something of a *Tron* vibe to the chassis, but we kind of like it.

While Alienware's Alpha was somewhat modular and allowed you to swap out the storage, RAM, and CPU, that's about all you could change. The Syber Vapor is much less proprietary and just about as modular as any Mini-ITX system. It can take a single full-length graphics card, handle up to 16GB of RAM, and can house a standard SFX PSU up to 800 watts.

The Vapor includes Logitech's F710 wireless gamepad, though we would have preferred the Xbox 360 equivalent. Our system also came with Logitech's K400 wireless keyboard. CyberPower PC opted to include this because, unlike Alienware, it didn't program its controller to emulate a mouse-and-keyboard setup. While we feel it's a bit of a cheap shortcut on CyberPower PC's part, the inclusion of the K400 keyboard does open it up as both a Steam box and a fully fledged Windows PC.

When it came to our Vapor's specs, we had little to complain about. While there are a couple of different configurations to choose from, CyberPower PC sent us its super-decked-out SKU, which you can

BENCHMARKS

	ZERO-POINT	
Stitch.Efx 2.0 (sec)	698	742 (-5.9%)
Proshow Producer 5 (sec)	1,176	1,261 (-6.7%)
X264	20	18 (-10.4%)
Batman: Arkham Origins (fps)	94	110
Bioshock Infinite (fps)	125.6	123.8 (-1.4%)
Hitman: Absolution (fps)	56.6	53.7 (-5.1%)
Unigine Valley	66.3	63.4 (-4.4%)
3D Mark 11 (Extreme)	5,714	5,461 (-4.4%)

0% 5% 10% 15% 20% 25% 30% 35% 40% 45% 50%

Our zero-point desktop is the one we built for our February 2015 cover feature. It features an i7-4790K Devil's Canyon processor and a GeForce GTX 980. All tests at 1080p.

There are seven LED color schemes to choose from.

check out in the specs chart below. The cost of our unit at the time of print came to $1,638, and while that certainly prices it well beyond the consoles, it's actually quite a bargain. In fact, when pricing out the build using the individual components through Newegg, the total tab came out at $1,807. So, you're saving over $150 here, and you get a one-year warranty to boot.

GAS ATTACK

To put it through the paces, we ran it against the full-tower system we built for the cover story of our February 2015 issue, which has the same CPU and GPU. As would be expected, the bigger chassis allowed the desktop to perform slightly better overall, with the Vapor trailing by 1 to 5 percent in our graphics tests. The Vapor did pull ahead of the desktop in *Batman: Arkham Origins*, but we suspect it's because of its newer GeForce drivers. As a gaming machine, our Vapor is a beast and should be able to max out any game you throw at it with smooth frame rates. When it came to the CPU benchmarks, the Vapor trailed the desktop by 5 to 10 percent, but we suspect that mostly has to do with the desktop's Kraken X61, which is a great liquid cooler.

Considering the Vapor is meant to connect to your HDTV, all its power is moot if the user experience isn't good. Upon initial boot-up, the Vapor scaled perfectly to our 1080p HDTV over HDMI. And speaking of booting, the startup process took 30 seconds. That's not super-fast, but more than three times as fast as the Alienware Alpha. Another plus for the Vapor is that it ran very quietly under load. Some games booted up in windowed mode, which was a small annoyance.

The Syber Vapor isn't perfect (and neither is Steam's Big Picture Mode), but as a Mini-ITX gaming PC, it rocks, especially for the price. In addition, it's got enough horsepower to eat any 1080p game you throw at it. Yes, it's relatively big and heavy, and a part of us would have preferred a smaller, cheaper, and more portable unit with a short GTX 970, but as it stands, this is still one pretty kick ass gaming PC. **–JIMMY THANG**

VERDICT **9** KICK A$$!

CyberPower PC Syber Vapor

+ VAPOR Powerful; great value; runs quiet; includes K400 keyboard; plenty of ports.

– VAPORWARE Not portable; no keyboard/mouse emulation for controller; Big Picture Mode isn't perfect.

$1,638, www.cyberpowerpc.com

SPECIFICATIONS

Processor	4GHz Core i7-4970K
Mobo	MSI Z97I AC
RAM	8GB LP DDR3/2133
Graphics	eForce GTX 980
Storage	120GB Kingston SSDNow V300 SSD, 1TB 2.5-inch 7,200rpm HDD
Optical	N/A
Case / PSU	Custom / Silverstone ST45SF-G 450W SFX PSU

Gigabyte BRIX S

Why, hello Mr. Broadwell...

SPECIFICATIONS

SKU	GB-BXi5H-5200
CPU	Intel Core i5-5200U @ 2.5GHz
Memory	Up to 16GB DDR3L SO-DIMM
Storage	1x 2.5-inch, 1x mSATA
Network	802.11 ac WiFi card, Gigabit LAN
Video	1x HDMI, 1x mini DP
I/O	4x USB 3.0, 1x 3.5mm headphone/mic
Dimensions	46.8 x 107.6 x 114.4mm

A sleek, small, but surprisingly mighty machine. For a price.

HOLD UP, HOLD UP. We know this is essentially a desktop machine and, yes, it has a Broadwell i5 processor in there, but this doesn't mean that Intel's newest CPU generation has actually made its way out of the low-power, mobile mindset. Gigabyte's latest BRIX S *is* rocking a new fifth-generation Core processor, but this is from the mobile U-series that Intel launched at January's CES.

The Core i5-5200U is a dual-core Broadwell chip with a TDP of just 15W, making it a great chip to fit inside a mini PC like Gigabyte's BRIX S. Despite that lowly TDP, you're still getting an impressive amount of performance from this wee chip—it may be dual-core, but thanks to the magic of Hyper-Threading you do get that split out into four threads of processing power. It's not going to be winning any medals for top frequency, but at a steady 2.5GHz, the 5200U manages a decent rate of knots considering its low-power status. The processor is rated to Turbo up to 2.7GHz, but testing just the single-threaded performance didn't help us raise those extra 200MHz of Turbo power.

NEW ARCHITECTURE

Not that it matters—this isn't some snarling workstation monster. You're not going to expect the BRIX S to breeze through heavy rendering, extreme math, or calculate the answer to the ultimate question. This is a tiny, fully fledged x86 PC that you could lose down the back of your TV if it wasn't bolted down. Indeed it's probably for that exact reason Gigabyte has included a VESA mounting bracket in the package; there's little more annoying than having your PC disappear down a crack in your furniture or spotting your cat carrying it off to bury in their litter tray.

What does Broadwell in this guise get us then? After all, the previous i5-powered BRIX was rocking a Haswell 4200U CPU with the same chilled-out 15W TDP. Unsurprisingly for a die-shrinking Intel Tick, not a huge amount has actually changed with the processor itself in the switch from Haswell to Broadwell. The CPU architecture remains as with Haswell, except with the teeniest transistors now being cut down into a 14nm lithography. That shrink allows the i5-5200U to maintain the same TDP but with a dramatically improved base clock speed. This i5 runs at 2.2GHz as standard while the ol' Haswell chip has a far more sedate 1.6GHz base.

But, as this is ostensibly a Tick+ in Intel parlance, the graphics side of the equation has had rather more attention. Intel has improved the geometry and tessellation hardware in Broadwell's HD Graphics and the HD 5500 revision in the BRIX S gets you an extra four execution units (EUs). What all that means is you're almost getting Haswell Iris Pro levels of gaming performance from this low-power part and that's a CPU with 40 EUs. We can't wait to see what Broadwell Iris Pro can do with 48 of these new EUs.

Admittedly that gaming prowess was when this barebones BRIX S was kitted out with 16GB of DDR3L running at 1,600MHz, but it's still a pretty impressive feat for this li'l box of delights. Dial things down in the graphics settings and drop to 720p and you'll be capable of some decent gaming on this box. It will also nail Steam's In-Home Streaming, though even the older, more basic BRIX could do that.

NOT-SO-MINI PRICE

The issue though is that it's still hugely expensive to put a decent BRIX S machine together. This barebones setup is some $350—that gets you the wee chassis, fitted out with the motherboard and chip soldered onto it. You also get the wireless card attached, four USB 3.0 ports, and a Gigabit Ethernet connection too. But you'll have to source your storage, memory, and OS yourself—the high-end spec of our review unit would have pushed the price up to around $800.

That makes the BRIX S a tough one to recommend. The form factor is a delight and the 15W TDP means the diminutive cooling array can remain almost silent even when it's running at full tilt. The new Broadwell CPU also means that it never feels like anything other than a proper desktop PC in use—it's quick, slick, and responsive. But when you're paying the sort of price that would net you a laptop with the same CPU and spec, it starts to make the BRIX look a little short on versatility by comparison.

–DAVE JAMES

BENCHMARKS

	Gigabyte BRIX S	MSI GS30
Cinebench R15	259	**612**
X264 v4.0	16.18	**35.24**
Heaven (min/avg fps)	3.2/5.1	**3.6/5.9**
Bioshock Infinite (min/avg fps)	4/7	2/9
GRID 2 (min/avg fps)	13/13	**13/18**

Best scores are bolded. The graphics benchmarks were run at their highest settings, with 4x AA running at 1080p. Punishing, we know... The GS30 is running a Haswell Iris Pro CPU for comparison.

VERDICT **8**

Gigabyte BRIX S

+ BRIX Tiny; practically silent; responsive; decent integrated GPU performance.

– DUPLO Expensive to fully kit out.

$343 (barebones), www.gigabyte.com

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Fractal Design Define R5

A defining moment? The successor to a classic has arrived

Both the R5's two main drive cages are removable.

IT'S AROUND TWO YEARS SINCE Swedish case designers Fractal Design launched the highly successful Define R4 case. And now we have its successor—the succinct Define R5. At first glance the new case looks pretty much the same as its predecessor, which is no bad thing. But as they say, the devil is in the detail and with the R5, Old Nick has certainly been busy.

The front door now has the option to be hinged on either side, a very useful update. The top of the case has three ModuVents fitted. Each of the three pop-out panels have a sound-proofed lining and cover the top of the case. They're ideal for building a quiet PC, but should the need arise for extra cooling then it's just a matter of fitting a fan or three in the roof and popping out the panel(s). The main side panel now has a locking latch as well as thumbscrews for extra security and the bottom dust filter has had a bit of a tweak. It now runs very nearly the length of the case and, with longer rails, it's easier to get in and out. The fact you can now pull it out from the front also gets a thumbs up.

TRAY IMPRESSIVE

There are plenty of drive options with the case. And then some. The R5 has two internal drive cages, the top one supporting five bays, the bottom one three. Each drive bay tray supports either 3.5 or 2.5-inch drives with rubber mounting grommets for 3.5-inch drives. Should you just want to use SSDs then there are two dedicated trays on the rear of the motherboard tray. The downside to all of these drive mounts is that you need a screwdriver to fix any drives in place.

But now the clever bit. The two main drive cages and the two optical bays for that matter are all removable and the cages can be fixed in a number of places to give much more freedom in how the internals are laid out in regards to cooling radiators, long graphics cards, and so on.

Fractal has designed the case to be as quiet as possible and to this end has fitted some good quality sound-absorbing materials to the front door and both side panels, plus fitted a pair of its own Dynamic GP14 140mm fans (one in the rear panel and one behind the front bezel). Should you feel the need for more cooling there are mounts for another seven—yes, seven—120/140mm fans.

COOL CUSTOMER

And it doesn't stop there. There's also a multitude of supports for liquid cooling. The roof can support radiators up to 420mm (with a 55mm limit on thickness), while behind the front bezel there's room for radiators up to 360mm (but the drive bays have to be moved). A 120 or 240mm radiator can be installed in the base but this does mean compromising on the length of the PSU. Finally the rear panel can support a 120 or 140mm radiator.

Fractal has even put some thought into something as mundane as the accessory box. It hasn't just chucked all the screws in a plastic bag, oh no. Each individual group is in its own bag so it's really easy to identify them with the aid of the very good user guide. Some 30 pages long, the guide tells you where everything is or goes with the aid of clearly drawn diagrams. It effortlessly knocks most other case manuals out of the park. **–SIMON CRISP**

VERDICT 8

Fractal Design Define R5

HIGH FIVE Flexible storage options; dedicated SSD mounts; superb manual.

LEFT HANGING Drive bays need a screwdriver; fan controller only supports three fans.

$205, www.fractal-design.com

SPECIFICATIONS

Motherboard support	ATX, mATX, M-ITX
Dimensions (W x H x D)	327 x 615 x 540mm
CPU cooler max height	180mm
Graphics card max length	Up to 440mm (with drive cage removed)
Storage support	2x 5.25in, 8x 3.5in/2.5in, 2x 2.5in dedicated

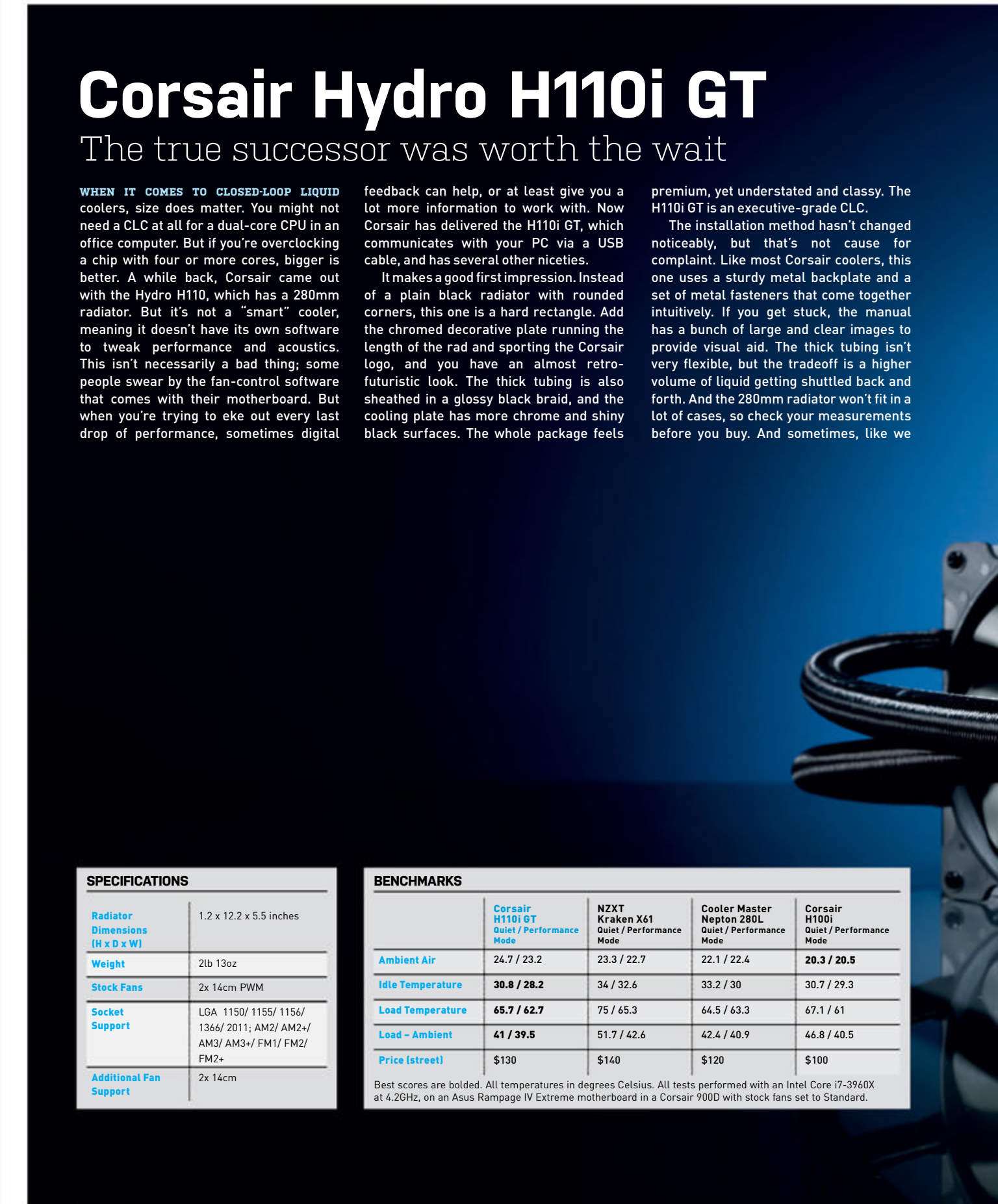
Corsair Hydro H110i GT

The true successor was worth the wait

WHEN IT COMES TO CLOSED-LOOP LIQUID coolers, size does matter. You might not need a CLC at all for a dual-core CPU in an office computer. But if you're overclocking a chip with four or more cores, bigger is better. A while back, Corsair came out with the Hydro H110, which has a 280mm radiator. But it's not a "smart" cooler, meaning it doesn't have its own software to tweak performance and acoustics. This isn't necessarily a bad thing; some people swear by the fan-control software that comes with their motherboard. But when you're trying to eke out every last drop of performance, sometimes digital feedback can help, or at least give you a lot more information to work with. Now Corsair has delivered the H110i GT, which communicates with your PC via a USB cable, and has several other niceties.

It makes a good first impression. Instead of a plain black radiator with rounded corners, this one is a hard rectangle. Add the chromed decorative plate running the length of the rad and sporting the Corsair logo, and you have an almost retro-futuristic look. The thick tubing is also sheathed in a glossy black braid, and the cooling plate has more chrome and shiny black surfaces. The whole package feels premium, yet understated and classy. The H110i GT is an executive-grade CLC.

The installation method hasn't changed noticeably, but that's not cause for complaint. Like most Corsair coolers, this one uses a sturdy metal backplate and a set of metal fasteners that come together intuitively. If you get stuck, the manual has a bunch of large and clear images to provide visual aid. The thick tubing isn't very flexible, but the tradeoff is a higher volume of liquid getting shuttled back and forth. And the 280mm radiator won't fit in a lot of cases, so check your measurements before you buy. And sometimes, like we



SPECIFICATIONS

Radiator Dimensions (H x D x W)	1.2 x 12.2 x 5.5 inches
Weight	2lb 13oz
Stock Fans	2x 14cm PWM
Socket Support	LGA 1150/ 1155/ 1156/ 1366/ 2011; AM2/ AM2+/ AM3/ AM3+/ FM1/ FM2/ FM2+
Additional Fan Support	2x 14cm

BENCHMARKS

	Corsair H110i GT Quiet / Performance Mode	NZXT Kraken X61 Quiet / Performance Mode	Cooler Master Nepton 280L Quiet / Performance Mode	Corsair H100i Quiet / Performance Mode
Ambient Air	24.7 / 23.2	23.3 / 22.7	22.1 / 22.4	**20.3 / 20.5**
Idle Temperature	**30.8 / 28.2**	34 / 32.6	33.2 / 30	30.7 / 29.3
Load Temperature	**65.7 / 62.7**	75 / 65.3	64.5 / 63.3	67.1 / 61
Load – Ambient	**41 / 39.5**	51.7 / 42.6	42.4 / 40.9	46.8 / 40.5
Price (street)	$130	$140	$120	$100

Best scores are bolded. All temperatures in degrees Celsius. All tests performed with an Intel Core i7-3960X at 4.2GHz, on an Asus Rampage IV Extreme motherboard in a Corsair 900D with stock fans set to Standard.

discovered in this month's "Build It" on page 68, it can technically fit but still require some maneuvering.

The main advantage of a radiator this large is that you can fit larger fans on it. Bigger fans can move the same amount of air, while generating less noise. This isn't always the case, but it's a general rule of thumb. And it's certainly true for the GT.

KILLER QUIET

With its fans and pump set to "Quiet" mode, we could barely tell it was operating, even when subjected to our torture test. When switched to "Performance," the GT gets fairly noisy, but nowhere near the racket produced by the standard H100i, which uses 120mm fans instead of 140mm. The H100i's fans get up to about 2,300rpm when cranked up, while the GT's hover around 2,000rpm on the same setting. The pump can also switch between these modes, which is something we're not accustomed to. Usually, pumps have either one speed, or they adjust themselves dynamically according to CPU temperature readings. Having different gears is an interesting change of pace, though we'd prefer an automatic shift over a manual one.

We should note that Corsair issued a partial "channel" recall on this cooler, meaning it asked stores to send it back. When subjected to sub-zero temperatures during shipping, some coolant could leak. If yours didn't show any signs of leakage, Corsair indicated you didn't need to do anything. If you haven't purchased a GT by the time you read this, then the original inventory should've been replaced by now. Our review unit showed no leakage in the package or during testing. If you still have doubts, it's covered by a five-year warranty.

Overall, the H110i GT's cooling and fan noise were some of the best we've ever seen. As you can see from the chart, it does so well in "Quiet" mode that "Performance" arguably isn't worth the additional noise. Then again, we test at a relatively manageable 4.2GHz, which keeps the playing field level for air coolers. If you're going for epic overclocks, this CLC will be hard to beat. **–TOM MCNAMARA**

VERDICT
9
KICK ASS!

Corsair Hydro H110i GT

MERCURY, GOD OF POETRY Runs cool; performs quietly; installs smoothly; looks snazzy.

MERCURY TRACER (1988) Thick tubing may make some installs tricky.

$130 (MSRP), www.corsair.com

This guy is powered via a SATA connector, so make sure you have one available.

When docked, the laptop screen isn't used, with all the video coming from the desktop GPU. But it doesn't make for as nice a picture...

MSI GS30 2M Shadow

A laptop with a desktop GPU? What voodoo is this?

THERE ARE LAPTOP PCS, and there are desktop PCs. And never the twain shall meet. Or at least that's how it's traditionally been. This hasn't, however, stopped the industry from trying to see if there's any way to bash the two things together and see what sticks. The MSI GS30 2M Shadow, with its GPU-toting Gaming Dock, could be the closest we've come to seeing a marriage of these two disparate gaming houses.

The GS30 laptop itself is a 13.3-inch machine, with a 1080p IPS panel and a seriously slim 'n' light chassis. And just because it's got the Gaming Dock to do most of the heavy lifting doesn't mean MSI has skimped on what it's put inside the laptop. The Intel Core i7-4870HQ is a full-fat quad-core, eight-thread processor, capable of turbo-ing to 3.7GHz. It's also got Intel's fastest GPU, the Iris Pro. Backing that up is a massive 16GB of DDR3 memory running at 1,600MHz. So yeah, it's no slouch.

You even get some light gaming performance, if you drop the resolution and post-processing niceties. The battery isn't going to offer much, however. We were unable to get it up to an hour of gaming, running down after just 56 minutes.

This is where the Gaming Dock comes in. Looking like an obese soundbar, it houses a 450W PSU and comes with an MSI GTX 980 Twin Frozr graphics card installed. Plug it into the wall, attach a monitor, keyboard and mouse, and you're good to go. If you want proper gaming performance you simply shutdown the laptop, place it atop the Dock, and pull the lever to lock and connect. The GS30 suddenly becomes a full desktop gaming PC with all the video coming direct from the Nvidia GPU.

The magic that connects with the desktop graphics card is a full x16 PCIe connector. This is where all other external GPU designs have failed. The XG Station Asus spent years trying to figure out used the old Express Card standard, which only supported a PCIe 1.1 connection at x1 speeds. The new Gaming Amplifier with the Alienware 13 laptop does use a PCIe 3.0 connection, but even that can only manage x4 speeds, hobbling any connected GPU.

MSI's solution uses the full power of the desktop card, as shown in our benchmark results. The numbers are only ever a few fps behind our Z97 zero point with a Core i7 and reference GTX 980. This is why the GS30 comes with a top-end mobile i7.

EYE ON THE FUTURE

The benefit of having this powerful a CPU is that it's going to outlast even the GTX 980. When you do come to plumbing a new GPU into the Dock, the Core i7 will still have the performance to keep up. The same with the 16GB DDR3 too—it'll be a long while before these become minimum requirements.

Hurrah then, we've finally got an external GPU adaptor for a laptop that just works. But there are teething problems. The cooling for the laptop CPU is loud and isn't capable of maintaining the 3.7GHz peak it initially offers. When you're gaming, it's not quiet, no matter how chilled out MSI's Twin Frozr cooling is on its GTX 980.

And that card is an issue. It's nothing less than the most expensive GPU MSI offers, and therefore dubious in value terms. The good news is Newegg already offers a version without the Twin Frozr and with SSDs scaled back to 256GB for $1,900, making it interesting for the upgraders. With an empty dock you could port over your GPU and storage from a desktop and have a powerful notebook that transforms into a desktop at the drop of a hat.

MSI admits itself the GS30 is a niche product and the Dock especially feels very first-gen. The biggest problem though is that it feels very much like the package has compromised both its ability to be a desktop PC as well as a decent notebook.

The lack of battery life on this otherwise great notebook is a cardinal sin. You wouldn't even be able to watch a movie without plugging in. That four-cell battery isn't enough to keep the top-end CPU running for long. And when combined with the dock, the noise the system creates is hugely distracting, especially as it's likely to be sat next to you. Right now a cheaper gaming notebook, like the G751 over the page, will deliver a better docked experience, if not quite with the same fps.

OK, you won't have the luxury of a GPU upgrade, but you'll have a quieter, longer-lasting gaming session right now. We're glad MSI has made the GPU dock work, but now we need refinement. **–DAVE JAMES**

VERDICT 7

MSI GS30 2M Shadow

THE SHADOW Unfettered desktop gaming performance; lovely thin 'n' light laptop; versatile Dock; easy to set up and use.

ALEC BALDWIN Noisy laptop cooling; expensive; feeble battery life; worth buying the empty Dock version.

$1,900 (w/o Frozr), www.msi.com

BENCHMARKS

	GS30	GS30 with Gaming Dock	Zero-point
Cinebench R15	612	636	**783**
X264 v4.0	35.24	36.81	**53.28**
Heaven 4.0 (min/avg fps)	3.6/5.9	26.5/74.7	**29.2/75.3**
Bioshock Infinite (min/avg fps)	2/9	17/120	**16/125**
GRID 2 (min/avg fps)	13/18	**130/165**	116/147
Metro: Last Light (min/avg fps)	3/6	27/53	**32/53**

Best scores are bolded. All graphics tests were carried out at 1080p with 4x AA. Our zero-point rig is an Asus Maximus VI Hero motherboard with an Intel Core i7-4770K @3.5GHz, with 8GB RAM, and an Nvidia GTX 980 reference.

SPECIFICATIONS

Screen	13.3-inch
Native resolution	1920x1080
CPU	Intel Core i7-4870HQ
GPU	Intel Iris Pro 5200, MSI GTX 980 Twin Frozr in Dock
Memory	16GB DDR3L
Storage	2x 256GB M.2 SSD Super RAID
Dimensions (W x D x H)	320 x 227.3 x 19.8mm

The G751JY may not have the svelte looks of the thin 'n' light crowd, but it's more powerful. And quieter.

Asus G751JY

In the face of powerful desktop parts powering other laptops, can Asus's mobile gamer compete?

THE CLASH OF THE DESKTOP REPLACEMENTS. That's how these successive reviews are going, and it's a proper battle royale. Except without the screaming kids, the fountains of blood, and "Beat" Kitano. First we had MSI's new take on the hybrid laptop (see page 82)—all gaming dock, upgradable GPU and floaty-light notebook fun—and now we have Asus's beefy trad gaming laptop, the G751JY.

And it's a hulking great beast of a machine. We're not just referring to it being a hefty 17.3-inch notebook weighing 11 pounds—it's also packed full of the best mobile hardware money can buy. Which is lucky, considering how much it costs.

The processor is top-end mobile Haswell fare, a fully Hyper-Threaded Core i7 capable of running up to 3.5GHz in this chassis, with a huge, if mostly unnecessary, 32GB of DDR3 memory, an M.2 512GB SSD (the Samsung XP941, featured in our April issue's SSD supertest), with a 1TB HDD, and an Nvidia GTX 980M. The keyboard and trackpad are worthy of note too. There are extra macro keys and buttons to launch Steam's Big Picture and Nvidia's game streaming software, while the trackpad is wide and responsive, with a pair of discrete buttons. It's so much better than the all-in-one trackpad abortions we've got Steve Jobs to blame for.

For the gaming performance, it's the range-topping Nvidia GPU that will get all the plaudits, but the screen Asus has used deserves a mention too. It's stunning. The 17.3-inch IPS panel has a native resolution of 1920x1080, but impressively the screen also runs at 75Hz. That's just 15Hz over the traditional 60Hz, but it makes a visible difference. Even before catching the numbers in the Nvidia control panel and game settings screens, we'd been impressed with the clarity and smoothness—this is a quality modern notebook screen. And it's no surprise it's the panel we've seen doing the rounds running the leaked mobile G-Sync driver to such good effect.

You may be less impressed by the 1080p resolution of that panel, but it's still an excellent option for a gaming notebook with a tight pixel pitch on a small screen. Put simply, it runs beautifully at that res. There's also the fact that higher resolution panels just aren't available in IPS trim at this size in decent or affordable volume.

PACKING THEM IN

That GTX 980M though does help make the screen look good, hurling around textured, tessellated polygons at fantastic frame rates. The Maxwell GPU isn't quite on a par with the desktop GTX 980 sat inside MSI's Gaming Dock, running to about 75 to 80 percent of that full-fat graphics silicon. But that still makes it more than a match for any 1080p games you wish to throw at it, and thanks to the chilled-out Maxwell architecture, it runs seriously quiet too.

You've also got the Asus chassis design to thank for that too. The thin 'n' light movement is all well and good for the notebook you take into meetings or sit with on the couch, distracting you from the horrors of your girlfriend binge hate-watching *America's Next Top Model*. But for a gaming laptop, packing components which really benefit from proper thermal attention, you need some girth in your chassis so you don't end up with the whining fans spinning up in a rushing cacophony.

That's one of the things which spoils the MSI GS30. Even when it's docked, the cooling on the CPU is always noticeable. Add in the low-level, but still persistent, noise of the Gaming Dock's GPU and PSU fans and you get an experience which is far from ideal. The G751JY on the other hand is whisper quiet even at full tilt. And that makes it a great desktop replacement to use as a docked machine too. Plug in a keyboard and mouse, output to a decent monitor, and you'd be hard-pushed to tell you weren't gaming on a full-fat tower PC.

And while we're comparing it with the MSI, this chunky, powerful gaming laptop will last longer away from the plug socket too. The eight-cell battery, combined with the low-power Maxwell chip, managed an extra eight minutes of gaming time against the svelte GS30 with its four-cell battery. It may not sound a lot, but that puts it at over an hour of high-quality gaming—and the gap increases when you're just watching video to over 40 minutes extra.

Asus's G751JY may not have the upgradability or gaming power of the MSI's Gaming Dock, but right now this chunky machine is a much better option, both on the go and plugged into a desktop monitor.

–DAVE JAMES

VERDICT **9**

Asus G751JY

GAMER Gaming performance; excellent screen; decent battery life; whisper quiet.

GATER Heavy; still deliriously expensive.

$2,798, www.asus.com

BENCHMARKS

	Asus G751	MSI GS30 w/ Dock (w/o Frozr)	Gigabyte P35X v3
Cinebench R11.5	6.74	6.90	**6.94**
Bioshock Infinite (min/avg fps)	15/95	**17/120**	9/86
Metro: Last Light (min/avg fps)	23/42	**27/53**	19/41
Shadow of Mordor (min/avg fps)	34/69	**38/87**	38/65
Price	$2,798	$1,900	$2,399

Best scores are bolded. All the gaming tests were carried out at 1080p on the highest game settings with 4x AA, with both minimum and average frame rates shown.

SPECIFICATIONS

Screen Size	17.3-inch
Screen Type	IPS
Native Resolution	1920x1080 @ 75Hz
CPU	Intel Core i7-4860HQ @ 3.5GHz
Memory	32GB DDR3L
Graphics	Nvidia GTX 980M
Storage	512GB Samsung XP941 SSD, 1TB HGST HDD

THE FUTURE OF PERFORMANCE solid-state drive storage lies with the PCIe interface. Set to usher in a new era of superfast SSDs, the M.2 storage interface is shoveling huge amounts of data down speedy PCIe lanes. And we're starting to see the green shoots of its continued development right now. More and more manufacturers have started to release M.2 drives, with the socket appearing in many new laptops and mainstream motherboards.

There's also the tantalizing prospect of the Non-Volatile Media Express protocol (NVMe) replacing the current AHCI setup, itself hobbling even the fastest PCIe SSDs with its many mechanical legacy hoops that SSDs still need to jump through. On top of that, thanks to Samsung's latest range of consumer drives, we're also getting 3D NAND Flash memory to sort out the storage density and longevity issues we've been suffering with.

So Samsung releases an M.2 850 EVO—the very drive range with its vertical, or V-NAND, memory—and we get all excited. Could this be the holy trinity of SSD advancement, a solid-state drive with 3D stacked memory, operating on the latest M.2 PCIe interface with the new NVMe protocol? Would that it were, dear reader. Would that it were...

HIGH HOPES

We can discount NVMe immediately. That much-vaunted SSD-specific protocol is still a while away from landing in our desktops. But we've still got an M.2 drive, right? Well, this is where things get really frustrating. Yes, the 850 EVO M.2 has been designed in that form factor, but it's using a little-known component of the M.2 interface—SATA. As well as providing a connection to the PCIe lanes of a motherboard, and support for both the AHCI and NVMe protocols, M.2 can also provide legacy support, plumbing directly into the SATA interface.

What we have here then is an M.2 drive that's unable to actually take advantage of this new interface properly at all. It doesn't matter if you plug it into a x2 or x4 slot, it will still just route everything straight through to SATA, suffering all the bandwidth limitations that the aging interface offers. Samsung is claiming this drive is designed for the consumer market, for those looking for a decent SSD upgrade for their M.2-sporting thin 'n' light notebooks. That's especially frustrating considering Samsung is still refusing to release its speedy XP941 or upcoming XP951 M.2 drives to the consumer market despite this tacit acknowledgement that consumers are ready to mess about with bare PCBs in their notebooks.

What's also tricky is that support for this bizarre subset of the M.2 interface is very limited when it comes to desktop motherboards. We went through all the Asus boards we have in the office with M.2 interfaces—and a PCIe expansion board too—and none supported it. Thankfully our ASRock X99X Killer Fatal1ty did, otherwise we wouldn't have got to be underwhelmed by the 850 EVO M.2's performance at all. At least not first-hand.

And underwhelming is definitely the word. If it were performing at the same level as the 2.5-inch drive, that would still be mildly disappointing for an M.2 form factor, but, considering its SATA limitations, not surprising. That, however, is not the case. Sequential read and write performance is on a par with what the 2.5-inch version can manage, namely sitting around the 500MB/s mark characterizing most current-gen SSDs, but the random 4K performance is well off the pace.

NOT WHELMED AT ALL...

The standard drive hits 36MB/s and 108MB/s respectively—about as fast as 4K performance gets right now—but this M.2 SATA version can only manage 22MB/s and 62MB/s. Those numbers are far from awful, but lag significantly behind the bargain $190 MX100 512GB drive. It's the same story for our real-world tests too, where it's half a minute behind its 2.5-inch sibling when it comes to our large Steam folder transfer. That's an enormous difference in performance.

We understand Samsung wants this to be an affordable drive for the thin 'n' light upgrade market, but releasing an M.2 drive without the expected performance benefits just seems odd. Especially when it plain refuses to properly release its super-quick XP941 to the public. So we're struggling to see why anyone would want this drive for their machine long-term—and by the looks of it cutting the 850 EVO's five-year warranty down to just three years for the M.2 version, Samsung's struggling too. **–DAVE JAMES**

VERDICT **6**

Samsung 850 EVO M.2

EVO Small; runs cool.

EGO SATA-limited; cut-down warranty; weak real-world performance; weak random 4K speeds.

$250, www.samsung.com

BENCHMARKS

	Samsung 850 EVO M.2	Samsung 850 EVO	Crucial MX100
AS SSD seq. read (MB/s)	**505**	494	499
AS SSD seq. write (MB/s)	**488**	485	474
AS SSD 4K read (MB/s)	22	**36**	24
AS SSD 4K write (MB/s)	62	**108**	106
5GB compression (sec)	79	**74**	**74**
30GB transfer (sec)	235	208	**191**

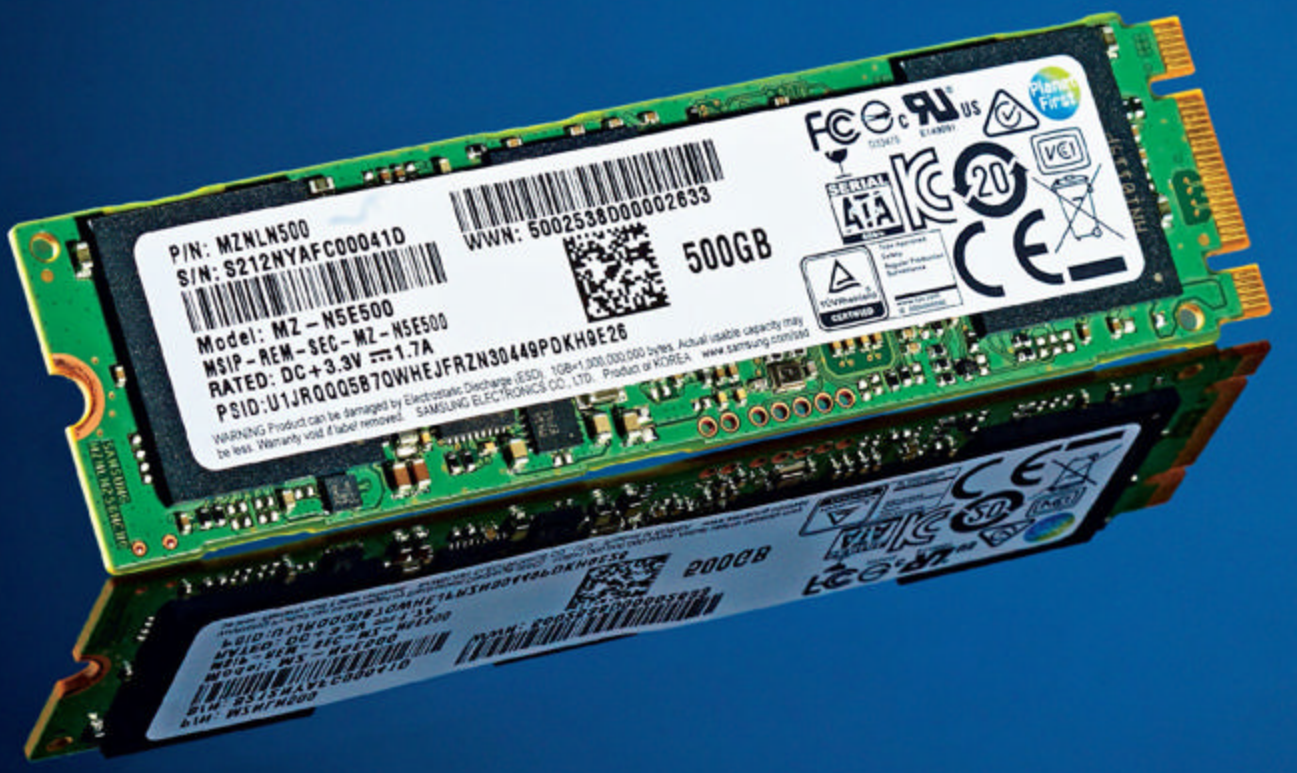
Best scores are bolded. The M.2 drive was tested on an ASRock X99X Killer Fatal1ty motherboard with an Intel Core i7-5820K, with 16GB DDR4 at 2,133MHz. The 2.5-inch drives were tested on an Asus RoG Maximus VI Hero with an Intel Core i7-4770K, with 16GB DDR3 at 2,133MHz.

SPECIFICATIONS

Capacity	500GB
Form factor	M.2 2280
Interface	SATA 6Gb/s
Memory controller	Samsung MGX
Memory type	Samsung 40nm 3-bit MLC V-NAND
Cache	512GB LPDDR3
Warranty	Three years

Samsung 850 EVO M.2

An M.2 SSD in name only



We're still waiting for M.2 drives with NVMe to arrive and fully deliver on the promise of PCIe storage.

Night Walkers are almost as good at parkour as you are.

Dying Light

Open-world zombies come up short on soul

FOR ALL ITS FLAWS, 2011's *Dead Island* has become the start of a booming media franchise. The open-world zombie-survival title will spawn two spin-offs this year: *Dead Island 2*, which is being handled by Yager Developments; and *Dying Light*, its spiritual successor from original developer Techland. *Dead Island* was not without its problems—notably a lot of grindy zombie action—but with *Dying Light*, Techland has introduced frenetic parkour into the mix of blood, guts, and gore that makes up the modern zombie game.

Dying Light's threadbare plot features Kyle Crane, an undercover operative tasked with entering the Middle Eastern city of Harran to collect a top secret file. When he arrives he finds the place in disarray—not really a surprise considering most of the residents are zombies. He's quickly recruited to do side quests by a ragtag group of survivors holed up in a tower block, but obviously they don't know the true nature of his objective. To add to his woes, Kyle has been bitten by a zombie and he's slowly turning into one, meaning he's effectively double-crossing the survivors, himself, and living people in general.

Crane doesn't have much to assist him in his quests across this rabid metropolis, other than a handful of withered weapons, balls of steel, and some swiftly learned parkour skills. He can run and jump his way across the city, hauling himself onto ledges, vaulting over walls, and cat leaping onto overpasses. This energetic method of getting around makes sense in Harran because the floors are basically lava.

HARDCORE PARKOUR

As soon as your feet hit the asphalt you become to zombies what One Direction are to most high school girls. The living dead will shuffle toward you and attack, and while it's generally not enough to kill you, it's just plain annoying. The fragile nature of your weapons doesn't help, so you really want to avoid combat unless it's absolutely necessary. Thankfully Harran's numerous rooftops are the safest places to hide and traverse. It takes a little adjustment, but one of the game's greatest joys lies in successfully planning and executing a rooftop maneuver.

Unfortunately, unsuccessfully planning and executing a rooftop maneuver is pretty damn frustrating, especially if you mistime a jump and plummet to your death, or just clumsily stumble off the top of a building. *Dying Light* doesn't include quicksaves or fast travel, and it even subjects you to an experience point penalty if you kick the bucket, so you've got plenty of compelling reasons to stay alive.

To begin with you'll kill yourself more often than you get eaten by the undead, but once you get the hang of it, it becomes fluid and exciting. The parkour's not quite as adrenaline-pumping as it is in *Mirror's Edge*, but what it lacks in stimulation it makes up in urgency. As impressive as *Mirror's Edge* is, it's a game that flails around trying to find a reason for you to suicidally leap across breakneck gaps. Motivation isn't a problem here—you simply don't really want to become chow for the once-living.

It's unfortunate, then, that the novelty of hauling yourself out of the way of plagues of zombies wears thin so quickly. The plot lurches forwards in a series of convoluted coincidences and cardboard characterizations. It pales in comparison to the *Fallout* series, which uses a similarly

What happens when you drink too much orange Mountain Dew.

Harran can look exquisite at times.

Sometimes, nothing is better than a poke in the eye.

You collect penalty points each time you die, so get to work.

desperate scenario to probe the darker regions of the human psyche in extreme conditions, but manages to keep up a wickedly black humor all the way through. The closest you'll get to funny here is kicking a zombie's ass until it falls into a spike and dies—a technique which works surprisingly often, by the way.

Other zombie-death techniques result in some gleefully deranged moments, too. Whacking a zombie with a variety of implements results in big chunks of rotting flesh flying out of their sides, and their love of loud noises results in all sorts of explodey fun. Certain pointy weapons can be thrown at zombies, but it falls apart a bit as soon as you get your hands on an automatic rifle—picking off the undead from a rooftop is simply so easy that it soon becomes mundane. The game even almost apologizes for this with two visits to the old take-his-guns-away trope.

On a purely technical level *Dying Light* is still quite an achievement. Techland has not only built a gorgeous city, but configured it so that you can fluidly parkour across it without clipping through the landscape. We only got stuck once—behind a pile of tables and chairs while we tried to hide in a school, and, to be fair, this is the kind of thing that happens to us in reality. Darkness is handled really well, too—night is a time when it actually gets pitch black, and your flashlight attracts Night Walkers, the scarier zombie variant that you can also play as in the enjoyable asymmetrical multiplayer part of the game.

CRAVING THE INSANE

Dying Light hits something of a crescendo, and becomes especially good-looking, once you manage to escape the slums and enter the opulent old town, where you vertiginously sprint across copper rooftops and slide down zipwires.

It's here that the game really finds itself, tightening the bagginess of the first half of the story. It's enough to make us wonder if Techland's next game should be more linear and less open world—the company is great at building zombie playgrounds and the means to negotiate them, but not so hot when it comes to tying them all together with interesting things to do.

There's certainly potential in *Dying Light*. The mere concept of "zombie parkour" is surely enough to put a smile on even the most cynical of gamer's faces, and it can be hugely pretty, and fun, at times. But it lacks the vital surprises and shock twists that we've become accustomed to in the best open-world games—a mere drop of *Just Cause*'s or *Saint's Row*'s insanity would have gone down well here, while more recent *GTA*s proved you can tell intimate human stories in the big city. The distinct lack of these elements makes *Dying Light* a game about the undead which fundamentally lacks both life and soul.

–HENRY WINCHESTER

VERDICT **7**

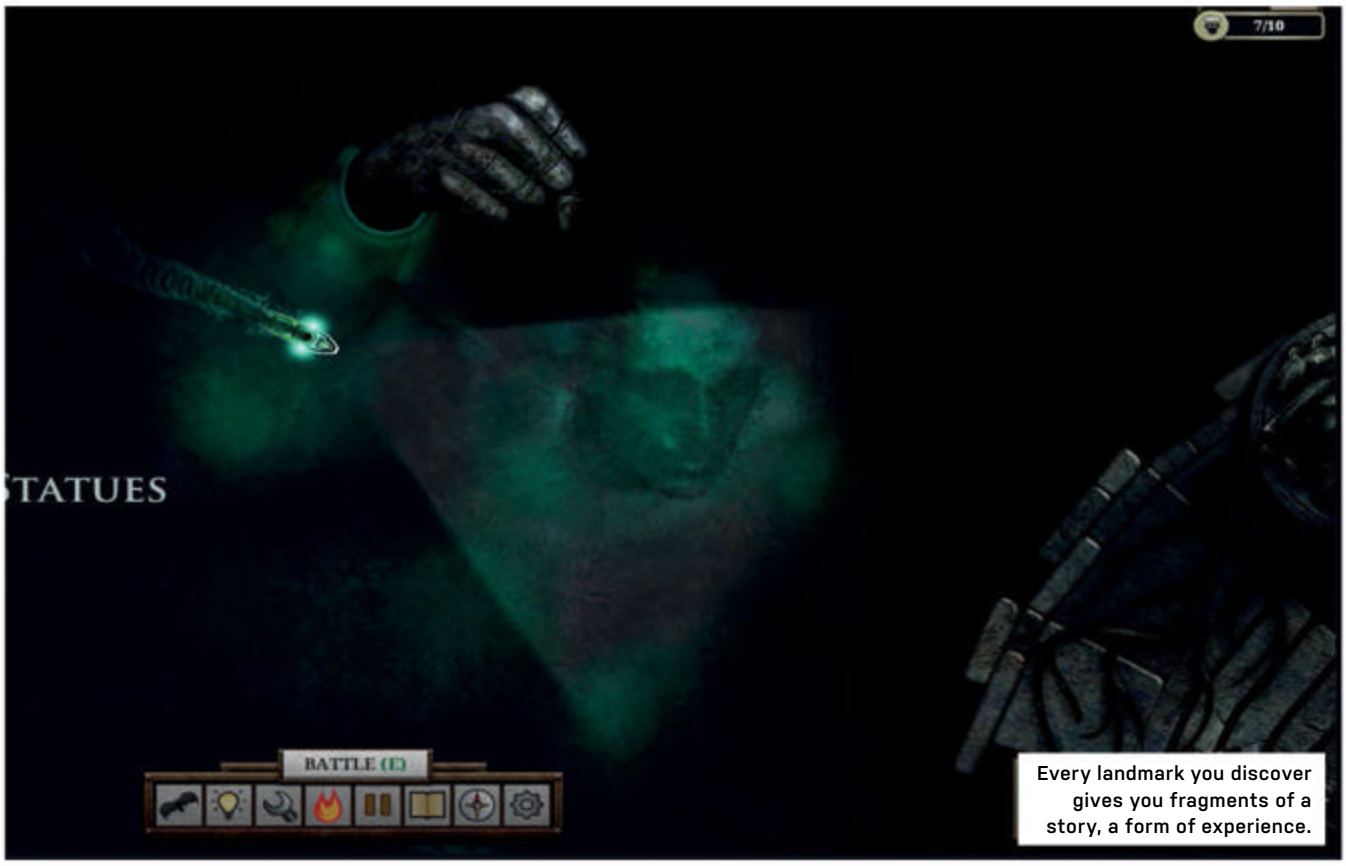
Dying Light

LIFE Fun parkour; good combat; handsomely mounted; decent multiplayer; excellent zombie dismemberment system.

DEATH Thinly plotted and predictable; no real depth; frustratingly unbalanced at times; doesn't live up to its promises.

RECOMMENDED SPECS 3GHz+ CPU; 4GB RAM; GeForce GTX 560/Radeon HD 6870.

$60, www.dyinglightgame.com, ESRB: M



Every landmark you discover gives you fragments of a story, a form of experience.

Sunless Sea

Sail into Hell's seventh circle, and back again

WE DON'T REMEMBER where our first captain was lost—almost certainly sailing in home waters, between Fallen London and Hunter's Keep. Later captains—men, women, citizens, all of the same doomed family—made it further. Another, fleeing with money stolen from the Smiling Man, made it as far as Khan's Shadow before the Khanate Navy sent his raggedy boat to the sea's bottom. We think one froze to death in the waters off Frostmourn. But none retired to a quiet life to put their seaboots up on the table. They all died in the shadowed seas, leaving their meager legacies to the next generation.

Sunless Sea is a narrative-heavy sailing game in a version of Victorian London that's literally descended into hell. Players take the role of a sea captain who sails that Unterzee, the great pool of water that fills the cavern to the east of the fallen city. You decide your goal at the start of the game—whether that's to find your father's bones, amass a great fortune, or just to have more stories to tell than anyone else.

You fulfil your goal by sailing the seas, talking to its denizens, and pursuing the stories of those you encounter to their final conclusion. However, the world is extremely hostile, so death is always just around the corner, either through the top-down exploration system or story choices. Players have to be careful or they'll have to restart from scratch (including the resetting of nearly all the story elements) with a new captain.

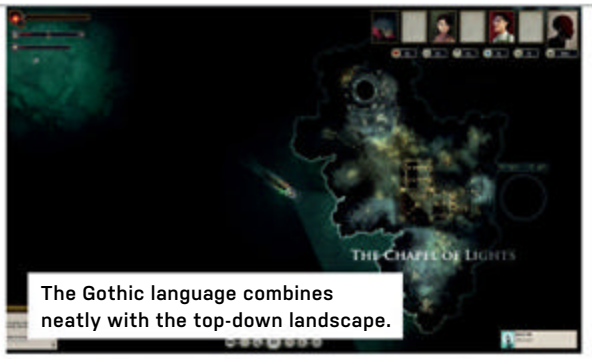
SEA SKILLS

Shortly, this is a combination of a Rogue-like and a narrative game. Though they're both implemented exceptionally, we'd quibble whether the two core game types fit together well. Rogue-likes require relentless replays and easy, frequent death. Narrative games are best when you encounter each story element just once and, as *Monkey Island* happily demonstrated, are better if they have no fail state.

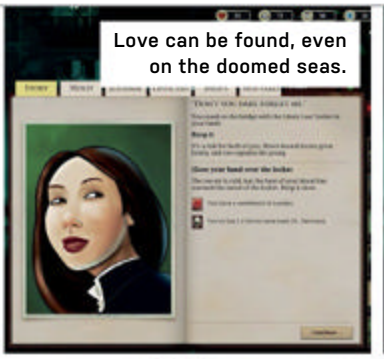
Developer Failbetter tries its damnedest to make these two work together, but they aren't a natural fit—meaning the game's normal mode, with permadeath and no manual save, simply doesn't work as well as the "save whenever you want" mode. When you've replayed the well-scripted Hunter's Keep sequence for the tenth time, it gets wearing, and you may find yourself switching to the more-forgiving manual mode, just so you can enjoy new content, rather than grinding away at the (slightly dull) exploration roguelike.

Despite that, *Sunless Sea*'s narrative is compelling enough to support the slightly shonky main structure. Fallen London is where you start your journey and where you return each time, to hand in quests and sell your loot and trade goods. But as you explore the world, more prospects open up and previously hostile islands reveal secrets—while previously welcoming islands close down.

They do this through a choose-your-own-adventure style game, mediated by your character. Each captain has a set of abstract skills derived from his abilities and those of his officers. So a high veils skill will allow you to avoid being spotted by enemies at sea, as well as passing tests on land that cover sneaking and deception. A high pages skill allows you to learn faster, hence unlocking increases in other skills



The Gothic language combines neatly with the top-down landscape.



Love can be found, even on the doomed seas.

The admiralty supplies most of your missions.

Later ships are more than capable of dealing with the threats of the sea.

faster. A high iron skill improves violence, on land and at sea. A high mirrors allows you to see better. And high hearts keeps you alive longer. It's a simple but effective way of gating your access to content.

Stories link together in unexpected ways. Picking up a strong box from a random encounter in Khan's Heart might do nothing until you happen across an island facility that's otherwise sealed. Deliver the box, and a range of other missions will unlock that tell you more about the odd semi-automata clay men, more about the world, and more about your own crew. Your ship's officers, who you pick up mainly in London, but sometimes on distant shores, each have their own story, if you can wine and dine them enough to get it out. Every story is exceptionally written, with tight descriptions that evoke the strange, darkly funny subterranean world.

As you explore the Unterzee, you'll encounter the denizens of the deep and piratical types, who you can avoid or fight. Those skills we mentioned translate nicely to this, helping you avoid combat (veils), improving your damage (mirrors and iron), and health (hearts). Though the combat is simple—it can't be said that it's complex or rewarding—you swiftly work out what you can and can't defeat, and after that they become at most an annoyance, at best something to farm for resources.

THE PIRATE BAY

Any great wealth you accrue can be spent on upgrading your ship, though often it bleeds away on fuel and supplies instead (and if you run out of those, you're doomed in many interesting ways).

Indeed, in the early game it can be hard to hold onto any money. Gradually, as you play, and as captains die, you work out good ways of making money—though they don't always last long. Simply traveling the sea, battling pirates, and visiting old and new ports is often the best way to make a living—though everything is a risk.

Sunless Sea is, essentially, a text adventure like Failbetter's previous effort *Fallen London*, with a pretty-pretty graphical user interface and a shallow combat mechanic. The Rogue-like elements breadcrumb out the enjoyment from the story, the exploration of the randomized world means that it's up to you how you explore it and what you find, and the combat adds a little peril to the otherwise dull steamboat experience.

With that criticism aside, the storytelling and atmosphere alone are enough to carry the game. *Sunless Sea*'s world is so intriguing, its characters so grotesque, and its mechanics so obscure, that it's the promise of exploring unusual minds in an unusual world from an unusual perspective, which makes for an unusually enticing prospect. –DANIEL GRILIOPOULOS

VERDICT **8**

Sunless Sea

CUTLASS Stunning story snippets in an original and wonderfully weird world.

GUTLESS Dull combat married with a thematically sound but disruptive Rogue-like mechanic that doesn't quite fit.

RECOMMENDED SPECS DirectX 9.0c graphics card; 2GHz processor; 1GB RAM.

$19, www.failbettergames.com, ESRB: N/A

LAB NOTES

JIMMY THANG **ONLINE MANAGING EDITOR**

It's OK to Buy Pre-built

Stop the PC shaming

IF YOU HAVE ANY LOVE FOR THE PC, you should learn how to build one yourself. But having said that, I realize not everyone has the time or patience to learn how to build a rig. Lately, I've noticed there's a negative stigma against people who buy pre-built machines. "Build it yourself," the judgmental commenters say, but I'd rather people buy pre-built PCs if it might be their only entrance into our awesome clubhouse.

Now, I'm not talking about your grandfather's old Dell or HP tower here. But boutique systems? They've come a long way. One argument you hear is that it's cheaper to build your own PC. This isn't always the case, however. I've reviewed CyberPower PC's Syber Vapor (see page 74) and the components inside are actually more expensive than the system itself. Plus, you get CyberPower PC's warranty.

Speaking of which, warranty and customer service can be a big factor, especially for the newbie. I've built several rigs for friends, but I've also been approached by friends who depend on computers to make a living. My gut reaction is to direct them to vendors like iBuyPower and CyberPower because these companies put together machines for cheap and have one-year warranties.

Moving on, there are certain awesome form factors that you can't build into even if you want to. Take Alienware's Alpha. The computer is little larger than an Xbox 360 controller and works great as a living room PC. And if you want to build into beautiful chassis like Digital Storm's Aventum III, you can't, as those vendors design their cases just for their PCs. And I'll tell ya, they are things of beauty. In addition, these system vendors take the time to overclock the components and ensure they're stable.

CyberPower PC's high-end Vapor system is cheaper than its individual components.

I'm not saying we should all buy pre-built PCs. I know I'll be building until the day I die. But if someone wants to buy pre-built, they have their reasons, and in this day and age, there are plenty of good reasons to do so.

TUAN NGUYEN

Editor-in-Chief

To produce more content you'll enjoy, I'm happy to say the team is expanding. We're making hires that will allow us to work on new features and cover more hardware.

We've also made the lab bigger. There's more space to build systems and test components. I say this with great enthusiasm because I genuinely believe both the magazine and website will receive a lot more TLC with our new setup.

Look out for more build-it guides, where we evaluate different components at different price points. Also more updates on the best of the best. More content, more detail, more analysis, more often—we wouldn't have it any other way.

TOM MCNAMARA

Technical Editor

I've been messing around a lot with *Star Citizen*, Chris Roberts's second coming after basically establishing the space-sim genre in the '90s.

It's an enormous project, and, by the time you read this, the FPS module and planetside/social module will be available to play. It marks an interesting turn for the game, which until now had only Arena Commander and the hangar to show for the tens of millions that people have pledged for the game.

The game itself is also an important touchstone. Roberts is known for pushing hardware and engines to their limits. Later this year, we'll be seeing the persistent universe alpha, which I'm sure will prompt a few upgrades.

First Look: Logitech G303 Daedalus Apex Performance Edition

Same compact G302 chassis, new and improved sensor

LOGITECH CAME BY THE *MPC* LAB recently to show off its new premium gaming mouse, the G303 Daedalus Apex. If you're thinking it looks just like the G302 Daedalus Prime, that's because it uses the same lightweight and portable body, tipping the scales at 87 grams and measuring 11.5 x 6.5 x 3.7cm. Logitech is saying this is the enthusiast version of the G302, hence the "Performance Edition" moniker.

The G302, with its unique metal spring tensioning system, was marketed as a MOBA mouse. The G303 uses this same system, which is guaranteed for at least 20 million clicks, supposedly equivalent to a pro gamer practicing 10 hours a day, every day, for two years. More importantly, the spring mechanic eliminates air travel time between clicks and activations. This ensures a speedy, consistent clicking experience. The G303 also retains the G302's five DPI settings, but it also has a few new tricks up its sleeve.

The biggest addition to this Daedalus is the PMW3366 sensor, which Logitech uses in the bigger G502. While it isn't as fast as its G402 sensor, which uses an optical/gyroscope hybrid solution that allows it to travel up to 12.7 meters a second, Logitech considers the PMW3366 to be its most accurate sensor.

The Swiss firm says this makes it about two to three pixels more accurate than the G302. That's not a monumental improvement, but it should amount to a slightly more responsive and accurate feel. Logitech also asserts that the sensor mitigates unwanted mouse acceleration and adds zero smoothing. The Apex offers a DPI range between 200 to 1,200. In addition, the sensor is much faster than the G302 before it, going from a cap of 120 inches per second, up to 300 inches per second. Logitech says this is fast enough for any real-world use and that it's able to achieve this speed via the sensor's clock tuning ability, which also helps prevent degradation of speed over time, essentially extending the life of the mouse. To top it off, the sensor also features sensor surface tuning, which tunes the mouse's parameters to match your desk surface for a consistent scrolling experience. All of this on top of a 32-bit ARM processor.

Beyond the sensor improvements, Logitech is also jumping on the RGB train (RGB... it's so hot right now). Some of you have clamored for more color options out of Logitech rather than the company's default blue hue, and it appears your voices were heard loud and clear on the shores of Lake Geneva. The G302 will feature 16.8 million colors (you can count them all, to be sure) and you'll be able to adjust the brightness or even have the LEDs pulsate. Conversely, you could just turn off the fancy lights if they don't tickle your fancy.

Wireless mouse fans may be disappointed to hear that it uses a cable, and a braided one at that, but Logitech says it went out of its way to make the cable more flexible than the average braided solution, so that you get the freedom of a plastic wire with the durability of a braided cable.

By the time this goes to press, you should be able to get your hands on the G303, which will retail for $70. Expect us to put these claims to the test with a full review in the near future. **–JT**

The Apex features 16.8 million colors.

GEEK TESTED & APPROVED

NomadClip

A solution looking for a problem?

DO YOU OFTEN LOSE YOUR KEYS or find yourself needing a USB charging cable for your smartphone? Well San Francisco–based Nomad wants to solve both problems with its NomadClip. The gizmo is a carabiner being advertised as "the most rugged USB cable you'll ever meet." Tucked inside the seemingly normal carabiner is either an Apple Lighting connector or Micro USB cable on one side, and a standard USB 2.0 cable on the other side. Both retail for 40 bucks. If that sounds like a lot, it's because it is. You can easily find cheapo USB connectors for less than five bucks.

OK, to be fair, it may be "the only carabiner clip that can also charge your phone." That may be true, but it's hardly the best way to charge your phone. Because the device doesn't come with a power brick, it's really meant to be plugged into computers. It works relatively well connected to laptops, but it's only around three inches long, so if you need to plug the standard USB end into the back of your tower, your phone will be dangling in midair, being held only the by the strength of your Lighting/Micro USB/USB connector.

On the bright side, the material does seem strong. Nomad says the carabiner uses "engineering-grade polycarbonate" and high-grade steel along with scratch-resistant metals, but it warns that it's "not for climbing." Even if you could climb with it, we still wouldn't recommend the NomadClip—not at 40 bucks, anyway. **–JT**

$40, www.hellonomad.com

LETTERS

WE TACKLE TOUGH READER QUESTIONS ON...

> NUC and 4K?
> Modular PSUs
> Fancy SLI Bridges

NUC with a View

Over the last 30 years, with the help of *Maximum PC*, I've built more than 120 rigs. The early ones were huge, noisy jobs, while my latest builds in NUCs have been near-silent yet plenty powerful, with i5 processors meeting our needs. (Thanks for your NUC articles, or I would never have tried this.) My current favorite screen setup is a 30-inch Dell or HP monitor with a 21-inch LG rotated 90 degrees beside it, giving me an effective 3760x1600 canvas. Your recent article on a budget 4K Philips 40-inch monitor has me wondering if I would prefer the step up to 4K with 3840x2160 in one screen.

If I go this route, will I be satisfied with the output from my Intel NUC 54250WYKH1 with its i5 and Intel HD 5000 graphics, or will I want to use one of my midtowers with an i7-3770 with a silent, fanless videocard like the Asus GTX-750-DCSL-2GD5? Or do I need to step up to something like an R9 290 or GTX 970 model, and if so, which will be the quietest solution? My use is primarily office, with occasional video watching and editing. I use 64-bit Windows 7 Pro in all my builds. I don't experience the scaling issues you mention in some of your 4K articles with my current setup. Will scaling be a problem for our office uses on a 4K monitor?

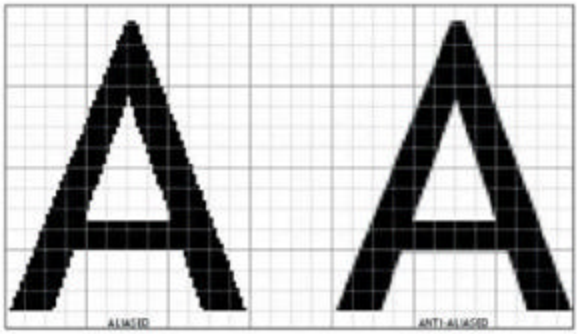
—Bruce Taylor, M.D.

TECHNICAL EDITOR TOM MCNAMARA RESPONDS: Hi, Bruce. Unfortunately, Intel's HD 5000 integrated graphics can't do 4K at 60Hz—only 30Hz. Fortunately, the HD 5500 or HD 6000 in the new "Broadwell" generation of CPUs can. Intel has just started releasing the NUCs that use these newer chips. The i3 version is in stock at Newegg now, so the i5 and i7 SKUs shouldn't be far behind. This is the i5 version to keep an eye out for: http://bit.ly/MPC_i5NUC. There's another version that ends in "K" that's even more compact, but you can't fit a 2.5-inch drive inside. And as you might expect, the i7 version is "NUC5i7RYH." As long as you're not gaming or using a GPU to encode video, the Broadwell NUCs should be fine. And if you're not having scaling issues with your current resolution, I don't foresee a problem bumping up to 4K.

[NOW ONLINE]

IN-GAME GRAPHICS SETTINGS EXPLAINED

Do in-game graphics settings confuse you? Are you not sure what anistropic filtering does? You might know what antialiasing is, but are you well-versed in the different AA techniques? Do you know which settings burden VRAM more than your GPU's processor? If not, then no worries. We go over texture quality, lighting quality, v-sync, and other knobs in detail in our guide to graphics settings. There are also before and after GIFs, so you can see what some of these settings look like enabled versus disabled. So, let us help you keep your fidelity looking sharp while keeping your frame rates high! Check it out here: http://bit.ly/MPC_graphics



Nvidia's demonstration of antialiasing.

Rockin' the Mods

I'm old-school and believe modular equals connection, and connection equals a place for a problem (or intermittent problem) to occur. I'm doing a new build. What is your advice on the type of power supply? Most of the power supplies I'm seeing that are in the 850-watt range are either semi-modular or fully modular. Are these types of PSUs reliable enough not

↘ submit your questions to: comments@maximumpc.com

to have to worry about some type of problem, versus a hard-wired power supply? Where are the hard-wired power supplies in the 850-watt range to be found?

—Rich

TECHNICAL EDITOR TOM MCNAMARA RESPONDS: Rich, in my experience, plugging in your modular cables and leaving them there has been a workable middle ground. It's frequent plugging and unplugging that causes contact deterioration. You can also use the color coding system—the "gold" rated units tend to have higher quality internal components than the "bronze" rated units. We've used this system with PSUs from Corsair, EVGA, Antec, Silverstone, and SeaSonic, to name a few, and haven't had an issue that appeared to be caused by modularity. This may not have been the case five to 10 years ago, but the major manufacturers seem to have modularity more or less figured out now.

Retro Revamp!

I've subscribed to *Maximum PC* for 12 years. I know gaming itself isn't this mag's specialty, and that building for the gaming experience is. I'd like to see some retro games reborn into the modern era and redesigned for today's hardware. A lot of new games are great, but some of the best games aren't around anymore. Let's take *Medal of Honor: Allied Assault*, which I think was ahead of its time. There were clan matches, full servers, and lots of enthusiasm. What I'd like to know is why this hasn't been kicked around.

—Joe Cava

> I'D LIKE TO SEE SOME RETRO GAMES REDESIGNED FOR TODAY'S HARDWARE.

EDITOR-IN-CHIEF TUAN NGUYEN RESPONDS: Hi, Joe. I feel you. I, too, was a huge fan of *BF1942*—I believe it was one of the most innovative games of its generation. I mean, wow! Land, air, sea, all rolled up into one. It was awesome. I think one reason why publishers don't rehash old titles is because they feel not many people would pay for nostalgia. And when I say not many, I mean millions. From a business standpoint, they have to keep producing titles that sell more. The number crunching is likely the main culprit for decisions that lean away from remaking an old title. This is probably why Square Enix hasn't made a *Final Fantasy 7* remake. It's arguably SE's pinnacle *FF* title, and although "a lot" of fans would want a *FF7* remake, in SE's eyes, "a lot" is not enough to satisfy sales goals.

Win7 Installation

I have a laptop that came with Windows 7 installed and no installation disks. I thought I read an article that explained a process for creating a Win7 installation disk. Not a recovery disk, but an actual installation disk. I can't seem to find anything in any recent issues or on your website. Any help will be much appreciated.

—Chris Bantz

TECHNICAL EDITOR TOM MCNAMARA RESPONDS: Hi, Chris. Marco Chiappetta created a guide a couple of years back. His weapon of choice is a USB stick, though. We've found USB flash drives install Windows much quicker. Here's the link: http://bit.ly/1M3oxJz. Good luck!

Bridging the Gap

I recently added a second reference GTX780 to my build, and have been searching for an SLI bridge—one that looks better than the average cable ribbon. When I came across your "Build It" article in the February issue, I fell in love with the bridge in the pictures. But it says it's an EVGA Pro SLI Bridge. After doing research, I found the SLI bridge in the picture is actually from Nvidia. Is the Nvidia bridge still available, or am I out of luck?

— Ryan Holland

TECHNICAL EDITOR TOM MCNAMARA RESPONDS: Thanks for catching that error on my part, Ryan. As far as I can tell, Nvidia no longer sells this unit. I found a number of listings on eBay, though, so I'd suggest grabbing one there. However, be aware they're quite expensive. Apparently these were only manufactured in limited quantities. Sorry I can't be of more help.

Facebook Polls

Big Mouse Bucks?

Is it worth spending more than $50 on a gaming rodent? That's what we asked our Facebook fans this month. Here are some of our favorite responses.

Brian Joudrey: I appreciate having a mouse that isn't a half-ounce plastic piece of junk. A solid and weighty mouse just feels more stable and comfortable.

Lilith Romanis: Yes! Currently, I'm gaming with a mouse that doesn't fit comfortably in my hand. I get cramps often. Mice that have the option of lengthening or other customizations are mice that I love!

Evan Gardner: No. Or rather, it depends. If I had the budget to spend a couple $K on a system, getting a $50 mouse would be nice. Until then, I'd rather use a $10 simplest-of-the-simple Logitech mouse and save the difference for getting a better GPU.

Andy Hornsby: As an MMO player, 100 percent yes. Got the Naga Epic Chroma and it's totally worth it.

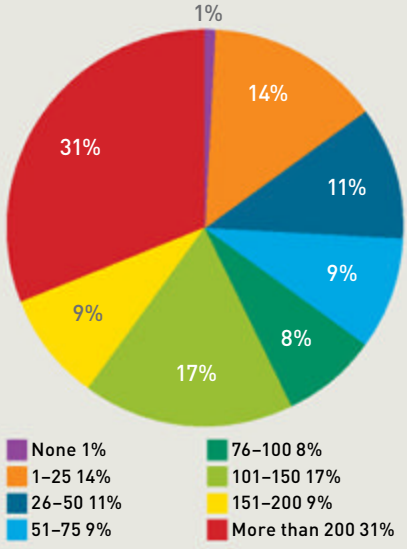
Rob Slater: I still love my 9-year-old Microsoft Sidewinder. That thing is perfect.

Chris Bamber: Yes. When you're in the heat of battle a good mouse will make the difference.

Nicholas Miller: No mouse is worth $50, let alone what they charge for a "gaming" mouse.

Nick Tredwen: Left-handed Naga. Because more buttons. And lefty. Finally. Best money I've spent, mouse-wise.

How many games do you have on Steam?



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THE BUILDS

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INGREDIENTS

PART		PRICE
Case	NZXT Source 210 Elite	$50
PSU	Enermax Revolution X't 530W NEW	$50
Mobo	Gigabyte H97-D3H	$95
CPU	Intel Core i3-4150	$120
GPU	XFX Radeon R9 285 R9-285A-CDFC	$183
RAM	2x 4GB Crucial Ballistix Sport XT DDR3/1600 NEW	$60
SSD	120GB SanDisk Ultra Plus NEW	$60
HDD	Seagate Barracuda 1TB	$60
OS	Windows 8.1 64-bit OEM	$100

Approximate Price: $778

WE TRY NOT TO RELY ON mail-in rebates too much, but this gold-rated Enermax power supply was too good to pass up—higher quality internal bits than the "bronze"-rated Corsair CX500M it replaces, and a five-year warranty instead of three. This SanDisk Ultra Plus SSD is $10 cheaper than the Ultra II, but it still has nice read and write speeds. Price fluctuations dictated a RAM brand switch as well. The Intel Core i3 chips remain a more balanced value than an AMD FX-6300, and the Gigabyte H97-D3H has a lot of features for the money. We debated going with a Radeon R9 280 because it has more VRAM, but the R9 285 is a bit faster as long as you don't go higher than 1080p.

MIDRANGE

INGREDIENTS

PART		PRICE
Case	Corsair Vengeance C70	$108
PSU	EVGA SuperNOVA 850 220-GS-0850-V1 NEW	$106
Mobo	MSI Z97 Gaming 5	$147
CPU	Intel Core i5-4690K	$230
Cooler	Cooler Master Nepton 280L	$120
GPU	Sapphire Tri-X Radeon R9 290	$270
RAM	2x 4GB Crucial Ballistix Sport XT DDR3/1600 NEW	$60
Optical Drive	Samsung SH-224DB/BEB	$20
SSD	240GB SanDisk Ultra II	$96
HDD	Seagate Barracuda 3TB ST3000DM001	$103
OS	Windows 8.1 64-bit OEM	$100

Approximate Price: $1,360

PRICES CREPT UP THIS MONTH. The EVGA SuperNOVA G2 power supply is back up around $150, so we've replaced it with the older version, which is still quite good. The Cooler Master Nepton 280L remains a nice cooler despite being $20 more now. Sapphire's Tri-X Radeon R9 290 also remains a strong performer that will run cool and quiet. The GTX 970 may be a bit faster in some benchmarks, but not enough for us to justify the premium. The Intel Core i5 remains the best all-around CPU at this tier, and the MSI Gaming 5 packs in a bunch of nice features for the price. The 850 EVO is our SSD of choice, but it was also about $30 more than the SanDisk Ultra II.

TURBO

YEAH, 1,300 WATTS IS CRAZY. But with a fat mail-in rebate, this EVGA SuperNOVA G2 is only a little bit more than the 1,000W version. So, why not? More headroom for an additional Nvidia GeForce GTX 980, a custom water-cooling loop, more overclocking, more fans, more drives, more everything.

The Intel Core i7-5820K, with its six cores and 12 threads, will need a healthy amount of juice. The dual 140mm fans on the Corsair H110i GT will draw some power as well. It's a slightly better cooler than the Cooler Master Nepton 280L, for slightly more money. Speaking of money, we finally saw 16GB of DDR4 dip decisively below $200. You could put 32GB in here, but we don't know what you'd actually get out of spending another $200 on that. We've also upgraded from the Gigabyte GA-X99-UD4 motherboard; overclocking felt much smoother with the Asus X99 Pro, plus it has integrated Wi-Fi, Bluetooth, an extra M.2 slot, onboard power and reset buttons, and some nice visual appeal.

For more of our component recommendations, visit www.maximumpc.com/best-of-the-best.

INGREDIENTS

PART			PRICE
Case	Corsair Obsidian 750D		$140
PSU	EVGA SuperNOVA 1300 G2		$157
Mobo	Asus X99 Pro	NEW	$315
CPU	Intel Core i7-5820K		$390
Cooler	Corsair H110i GT	NEW	$130
GPU	2x EVGA GeForce GTX 980 Superclocked ACX 2.0		$1,100
RAM	4x 4GB Crucial Ballistix Sport DDR4/2400	NEW	$187
Optical Drive	LG Blu-ray Burner WH16NS40		$70
SSD	Samsung 850 EVO 500GB		$230
HDD	Seagate Barracuda 3TB ST3000DM001		$103
OS	Windows 8.1 64-bit OEM		$100

Approximate Price: $2,922

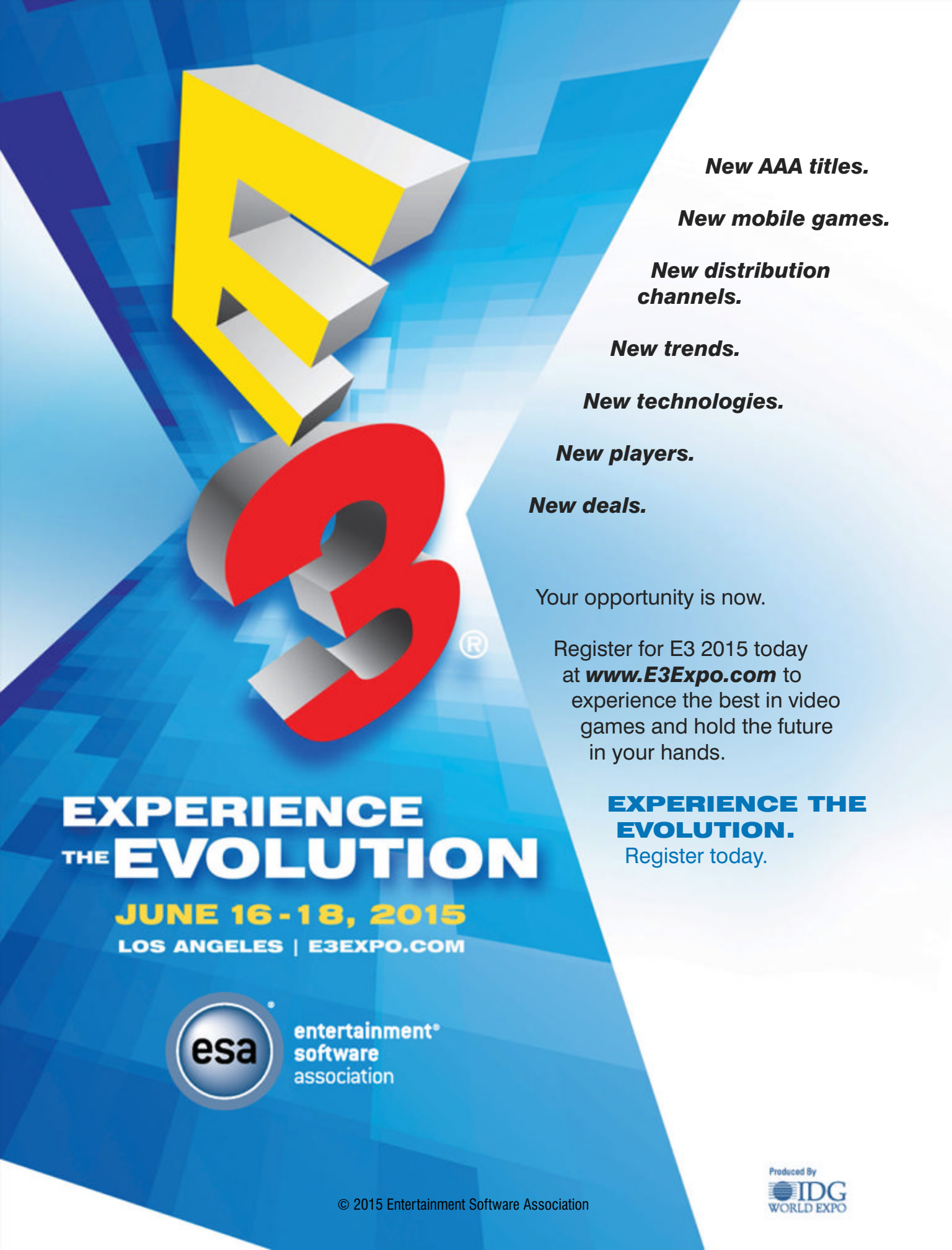
UPGRADE OF THE MONTH

CORSAIR GRAPHITE 380T CASE

Despite its compact dimensions, this Mini-ITX case will take a full-length videocard, 240mm radiator, and 200mm intake fan. And it has a three-speed fan controller. It also has crazy airflow, easy-access side panels, and a sturdy integrated handle. It's not cheap, but its features are hard to beat.

$140, www.corsair.com

MAXIMUM PC (ISSN 1522-4279) is published 13 times a year, monthly plus Holiday issue following December issue, by Future US, Inc., 4000 Shoreline Court, Suite 400, South San Francisco, CA 94080. Phone: (650) 872-1642. Fax: (650) 872-2207. Website: www.futureus.com. Periodicals postage paid in San Bruno, CA and at additional mailing offices. Newsstand distribution is handled by Curtis Circulation Company. Basic subscription rates: one year (13 issues) US: $19.95; Canada: US$24.95; Foreign: US$34.95. Canadian and foreign orders must be prepaid. Canadian price includes postage and GST (GST #R128220688). PMA #40612608. Subscriptions do not include newsstand specials. POSTMASTER: Send changes of address to Maximum PC, PO Box 5852, Harlan, IA 51593-1352. Standard Mail enclosure in the following editions: None. Ride-Along enclosure in the following editions: None. Returns: IMEX Global Solutions, PO Box 25542, London, ON N6C 6B2, Canada. Future US, Inc. also publishes GGamer, MacLife, The Official Xbox Magazine, and PC Gamer. Entire contents copyright 2015, Future US, Inc. All rights reserved. Reproduction in whole or in part is prohibited. Future US, Inc. is not affiliated with the companies or products covered in Maximum PC. Reproduction on the Internet of the articles and pictures in this magazine is illegal without the prior written consent of Maximum PC. Products named in the pages of Maximum PC are trademarks of their respective companies. PRODUCED IN THE UNITED STATES OF AMERICA.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